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PROCEEDINGS. CONFERENCE IN THE MATTER OF POLLUTION OF THE NAVIGABLE WATERS OF BOSTON HARBOR AND ITS TRIBUTARIES, SESSION (2ND) HELD AT BOSTON, MASSACHUSETTS ON 30 APRIL 1969

Federal Water Pollution Control Administration
Boston, Massachusetts

30 April 1969

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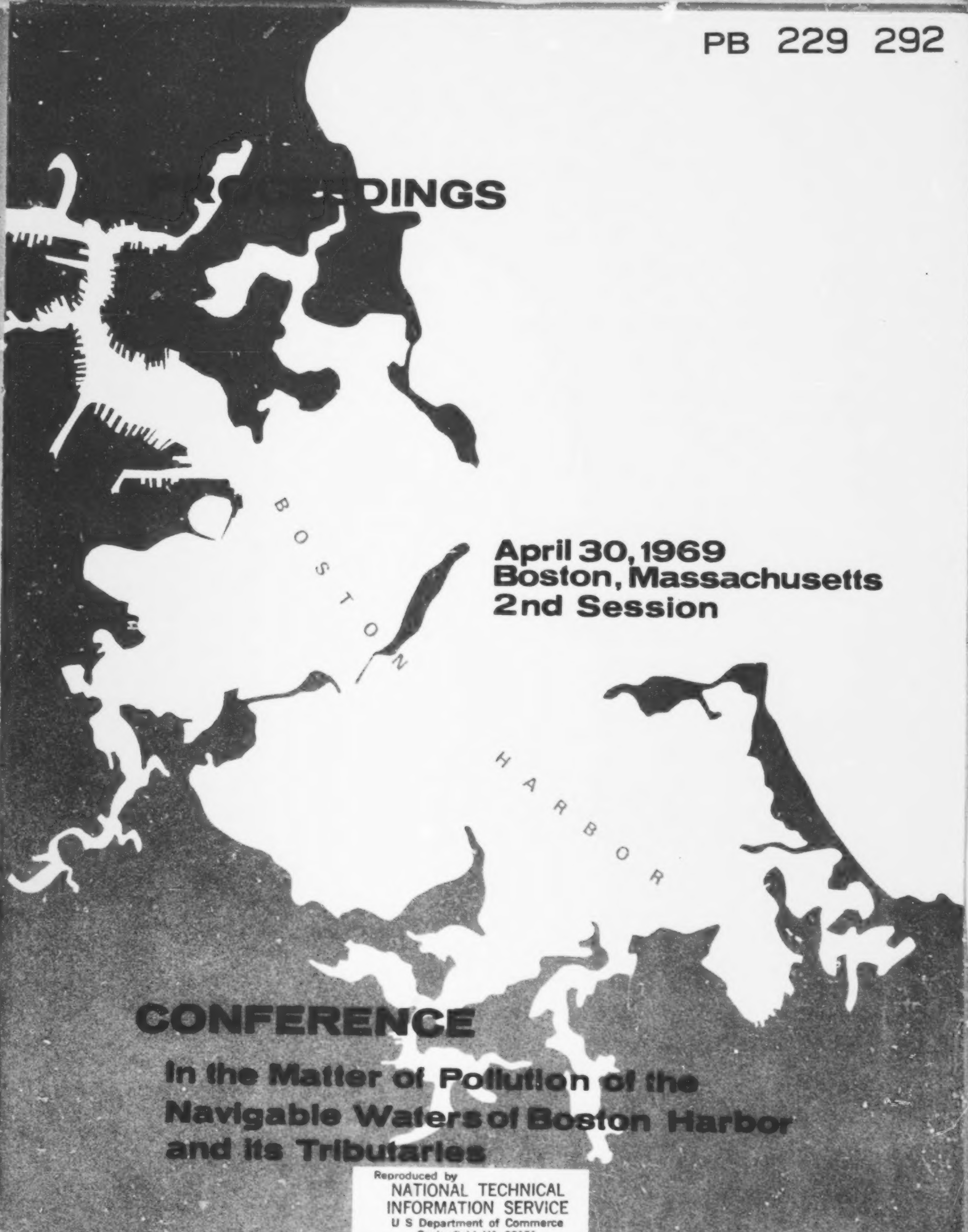

PROCEEDINGS

April 30, 1969
Boston, Massachusetts
2nd Session

CONFERENCE

In the Matter of Pollution of the Navigable Waters of Boston Harbor and its Tributaries

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PROCEEDINGS

SECOND SESSION
Boston, Massachusetts
Wednesday, April 30, 1969

CONFERENCE
IN THE MATTER OF POLLUTION OF THE NAVIGABLE
WATERS OF BOSTON HARBOR AND ITS TRIBUTARIES.

DEPARTMENT OF THE INTERIOR

FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

CONFERENCE

IN THE MATTER OF POLLUTION OF THE NAVIGABLE WATERS OF BOSTON HARBOR AND ITS TRIBUTARIES.

Second Session
Parker House
Boston, Massachusetts

Wednesday, April 30, 1969

Convened, pursuant to notice, at 9:35 a.m.

Murray Stein, Chairman	Assistant Commissioner for Enforcement Federal Water Pollution Control Administration U.S. Department of the Interior
Tom McMahon	Conferee Commonwealth of Massachusetts
Arthur Brownell	Conferee Commonwealth of Massachusetts
Lester Klashman	Conferee and Regional Director Federal Water Pollution Control Administration Northeast Region Boston, Massachusetts

Second Session of Conference in the matter of Pollution of the Navigable Waters of Boston Harbor and its Tributaries, convened at the Parker House, Boston, Massachusetts, on April 30, 1969.

PRESIDING:

Mr. Murray Stein, Assistant Commissioner for Enforcement, Federal Water Pollution Control Administration, U.S. Department of the Interior

CONFEREES:

Thomas C. McMahon, Director, Division of Water Pollution Control, Massachusetts Department of Natural Resources, Boston, Massachusetts

Arthur Brownell, Commissioner of Natural Resources, Massachusetts Department of Natural Resources, Boston, Massachusetts

Lester M. Klashman, Federal Water Pollution Control Administration, U.S. Department of the Interior, Boston, Massachusetts

Murray Stein, Chairman, Federal Water Pollution Control Administration, U.S. Department of the Interior, Washington, D.C.

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PROCEEDINGS

OPENING STATEMENT

BY

MR. MURRAY STEIN

Chairman STEIN. The conference is open. The second session of the conference in the matter of pollution of the navigable waters of Boston Harbor and its tributaries in the State of Massachusetts is being held under the provisions of Section 10 of the Federal Water Pollution Control Act, as amended.

Under the provisions of the Act, the Secretary of the Interior is authorized to initiate a conference of this type when he finds that substantial economic injury results from the inability to market shellfish or shellfish products in interstate commerce because of pollution subject to abatement under the Federal Act, and action of Federal, State or local authorities.

The first session of this conference was called by the Secretary of the Interior and held on May 20, 1968.

Both the State and Federal governments have responsibilities in dealing with water pollution control problems. The Federal Water Pollution Control Act declares that the States have primary rights and responsibilities for taking action to abate and control pollution. Consistent with this, we are charged by law to encourage the States in these activities.

At the same time, the Secretary of the Interior is charged by law with specific responsibilities in the field of water pollution control in connection with pollution of interstate and navigable waters.

The purpose of the conference is to bring together the State water pollution control agency, representatives of the U. S. Department of the Interior, and other interested parties to review the existing situation, and the progress which has been made, to lay a basis for future action by all parties concerned, and to give the States, localities and industries an opportunity to take any indicated remedial action under State and local law.

The Massachusetts Department of Natural Resources will be represented by Mr. Arthur Brownell and Mr.

Thomas McMahon. The Federal conferee is Mr. Lester Klashman Regional Director, Federal Water Pollution Control Administration.

My name is Murray Stein and I am from headquarters of the Federal Water Pollution Control Administration in Washington, D. C., and the representative of Secretary Hickel.

The parties to this conference are the official State water pollution control agency and the U. S. Department of the Interior. Participation in this conference will be open to representatives and invitees of these agencies and such persons as inform me that they wish to present statements. However, only the representatives of the State water pollution control agency and the U. S. Department of the Interior constitute the conferees.

The first session of the conference concerning Boston Harbor and its tributary basin was held a little less than a year ago. At that time the conferees recommended that:

1. A technical committee be appointed to be chaired by the Chairman of the Massachusetts Department of Natural Resources, the Federal Chairman of the New England River Basins Commission, and the Northeast Regional Director of the Federal Water Pollution Control Administraiton. The

committee shall be empowered to appoint subcommittees and expand its membership. The committee will make an evaluation of the following and report to the conferees at six-month intervals. The scope of such evaluation will include but not be limited to:

a. A status report of pollution abatement required by the Division of Water Pollution Control for all municipal and industrial contributors listed in the Massachusetts Standards of Water Quality, including Federal installations as well.

b. A report of the attainment of Boston Harbor Water classification by the several municipal and industrial pollution sources.

c. Delineation of an overall plan to control the dumping of garbage or refuse along the shores and in the Harbor.

d. A program to improve dump sites and correct the problem of sunken vessels, deteriorating piers and debris.

e. Investigation of suitable Federal and State laws to control oil pollution and wastes from watercraft.

f. Study of a deep-tunnel proposal from a water quality and use standpoint as well as consideration of the most feasible means of financing such a project.

g. Plans to assist Federal authorities in the implementation of treatment works for Federal installations.

2. Federal installations will be required to meet the time schedule of Massachusetts' Water Quality Standards. Nike Ajax Site B-36 (Hull) will be required to make a determination in six months as to whether it will join the municipal system or provide its own installation and have its remedial system or facility put in by eighteen months from the date of this conference. The Coast Guard's Deer Island Light Station will be given six months to put in a temporary facility. The Coast Guard's Base Boston Station should complete its remedial facilities by May 1970. Base Boston vessels in port are to observe May 1970 as the completion date for control and treatment of their wastes. The Naval Shipyard should have its remedial facility for collection and control of its wastes from machine shop tank cleaning operations completed by July 1969.

This conference session has been called so that the conferees may receive and consider the report of the technical comittee and review progress.

Now a word about the procedures governing the conduct of the conference. The conferees will be called upon to make statements. The conferees, in addition, may call upon participants whom they have invited to the conference to make statements. In addition, we shall call on other interested individuals who wish to present statements. At the conclusion of each statement, the conferees will be given an opportunity to comment or ask questions, and I may ask a question or two. This procedure has proven effective in the past in reaching equitable solutions.

At the end of all the statements, we shall have a discussion among the conferees and try to arrive at a basis of agreement on the facts of the situation. Then we shall attempt to summarize the conference orally, giving the conferees, of course, the right to amend or modify the summary.

Under the Federal law, the Secretary of the Interior is required at the conclusion of the conference to prepare a summary of it which will be sent to the conferees. The summary, according to law, must include the following points:

1. Occurrence of pollution of interstate waters subject to abatement under the Federal Act;

2. Adequacy of measures taken toward abatement of pollution; and

3. Nature of delays, if any, being encountered in abating the pollution.

The Secretary is also required to make recommendations for remedial action if such recommendations are indicated.

A record and verbatim transcript of the conference is being made. It takes about three or four months for the transcript to come out in printed form, and this will be available from your State agencies.

In addition, the summary will be made available through the State agencies, and people wishing a copy should get in touch with their State agency.

I would suggest that all speakers and participants, other than the conferees, making statements, come to the lectern and identify themselves for the purposes of the record.

At this point I would like to call on Mr. Thomas McMahon of Massachusetts.

Mr. McMAHON. Mr. Chairman, fellow conferees and guests:

Honorable Francis W. Sargent

We are delighted this morning to have with us His Excellency, the Governor of Massachusetts, the Honorable Francis W. Sargent.

HONORABLE FRANCIS W. SARGENT, GOVERNOR,
COMMONWEALTH OF MASSACHUSETTS, BOSTON,
MASSACHUSETTS

Governor SARGENT. Mr. Chairman, members of your distinguished committee, conferees, participants and guests, it is my pleasure today to represent the Commonwealth of Massachusetts in the conference. We hope very much that it will accelerate the cleanup of Boston Harbor and permit maximum shellfish, recreational, commercial and other water uses of the harbor for the people of Boston, the people of the metropolitan area, and, in fact, for the people of New England.

In 1966 Massachusetts enacted one of the nation's most comprehensive water pollution control programs. We established a new Division of Water Pollution Control in the Department of Natural Resources under the Massachusetts Water Resources Commission.

We set up a 150 million dollar bond issue to aid local construction of waste treatment facilities, and we provided for tax inducements for industries constructing their own treatment works.

After Federal grant fund cutbacks, we sponsored legislation to allow the Commonwealth to advance the Federal share of costs of eligible projects to communities in anticipation of future Federal reimbursements.

A further aid was a system of advancing seven per cent of the estimated construction costs of community projects to permit drafting of final plans and specifications.

Since the inception of the State construction grants program, grant offers have been made to 43 communities and districts involving a total construction cost of about 55 million dollars. The Commonwealth has also prefinanced some ten million dollars in State funds due to the restricted Federal grant appropriations.

The Boston Harbor situation is improving. We acknowledge difficulty and delay in making the Metropolitan District Commission Deer Island Treatment Plant operational. Now that it is finally working, we look forward to significant benefits from increased water quality.

Honorable Francis W. Sargent

But the Boston Harbor problem is as complex as it is formidable, and waste treatment is only one part of it. We face equally difficult problems of floating debris, rotting piers and piling, oil pollution, commercial, military and pleasure boat pollution, storm runoff and enormous technical and economic problems involved in combined sewer discharges involving several communities, districts, industries and governmental agencies at all levels.

Despite these obstacles, Massachusetts has not turned its back on Boston Harbor and its problems. We are confronting these problems with a series of direct action programs.

Last May I participated in the first session of this conference and recommended the formation of an investigating committee to report to me at this time. The committee has discharged its responsibilities in the form of a joint report by the Massachusetts Division of Water Pollution Control and the Federal Water Pollution Control Administration. This report will be made part of the transcript of these proceedings and will be submitted for the record.

One of the more vexing problems facing our abatement program is the lack of adequate Federal financing for some 140 communities which are scheduled in the next few years to construct sewage treatment facilities on the interstate, intrastate and coastal and marine waters. Despite State efforts to streamline the program, the key to an overall cleanup effort is tied to massive Federal grants in line with the authorizations spelled out in the Clean Waters Restoration Act of 1966.

If I may be permitted to relay one message back to Washington, it would be this:

The Massachusetts pollution abatement program is moving ahead at an accelerated rate, primarily, however, on our own funds -- Massachusetts funds. If we are to maintain this momentum, the Federal government must honor its financial commitments in the form of increased money authorizations for grants and a separate fund to reimburse the States that have been prefinancing the Federal share for construction of waste water facilities.

In the earlier session of this conference a proposed deep tunnel plan was discussed as a potential comprehensive solution for Boston Harbor's problems. Financial ramifications, of course, are tremendous. The one-half billion dollar price tag is presently beyond the financial resources of the associated communities and the M. D. C. The realization of a pollution abatement project as vast as this could only be accomplished by a massive civil works program Congressionally authorized and financed primarily by Federal funds.

In the meantime, we must continue to improve our ongoing programs of waste treatment, tide gate rehabilitation, construction of interceptors, and the correction of the problems associated with refuse and garbage dumping and deteriorating piers and debris.

I have long warned that we are making a tragic mistake in turning our back on the sea in Massachusetts and, in particular, turning away from Boston Harbor.

We should be doing precisely the opposite -- turning toward the sea, toward the harbor and realizing that by insuring its future, we enhance a natural bounty that will pay us richly in commercial and industrial growth as well as recreational opportunities and living potential for this great metropolitan area and for the Commonwealth as a whole.

Few conferences that are going on and that are going to be held in Boston this year are going to be as important as this one, in my opinion. If we can at long last move forward in changing Boston Harbor in terms of making Boston Harbor what it can be and what it should be, I believe then we will have some reason for pride and accomplishment, not only on behalf of the city, but in relation to the State and the Federal agencies that, together, must, in my opinion, perform this work. We feel that we have the tools. We need the wherewithal, and we certainly have the interest on the part of everyone involved.

I am glad to be able to participate in your conference. I think it is important. I would like to be able to stay throughout your session, but I am not able to.

I want to say to you, Mr. Chairman, and the members of the committee, I appreciate very much the opportunity of sharing these thoughts with you, as Governor of Massachusetts.

Thank you very much. (Applause.)

Chairman STEIN. We can continue, and I think we all welcome the Governor's statement.

As you can appreciate, he has a very sophisticated understanding of the problem. He has worked very closely with Water Pollution Control before he became governor, and you can see the evidences of that interest in the speech and the approach that the Governor has taken. He has hit all the salient points and problem areas in this situation; with this interest and analytical ability and push in government, we are well on our way to the efficacious handling of these Boston Harbor projects.

Mr. McMahon, did you have anything further you wanted to say?

Mr. McMAHON. Thank you, Mr. Chairman.

I agree wholeheartedly with the salient features of the Governor's speech. I think they are comprehensive and very meaningful.

Mr. Chairman, with your approval and the approval of the other conferees, I do have a little statement that we would like to read into this conference.

Chairman STEIN. Certainly.

Mr. McMAHON. Mr. Chairman, the Massachusetts Division of Water Pollution Control is present today for the second session of the Federal Enforcement Conference on

Boston Harbor in the spirit of cooperation with the Federal Water Pollutiion Control Administration.

The material, whether written or oral, presented at this conference shall in no way commit the Commonwealth to changes in the Massachusetts Standards of Water Quality approved by the Massachusetts Water Resources Commission and the Secretary of the Interior, and shall not convey any authority that transcends the jurisdictional responsibilities of the Massachusetts Clean Waters Act or the Federal Water Pollution Control Act.

As Mr. Stein mentioned earlier in his opening remarks, there has been a joint report prepared by the Massachusetts Division of Water Pollution Control and the Federal Water Pollution Control Administration. We are going to now present the summary and recommendations of this report. As Mr. Stein earlier indicated, the full report will be made part of the transcript. This will probably be not available for two or three months. However, if anyone doesn't have a copy of the summary and recommendations, I believe they are at the back of the room, and you can pick them up there.

I would also like to indicate that the Joint Report on Pollution of the Navigable Waters of Boston Harbor dated April 1, 1969, was prepared by the Subcommittee and has been approved by the Technical Committee, and I would like it to be included in the transcript in its entirety as if read.

Chairman STEIN. Without objection that will be done.

JOINT REPORT ON POLLUTION OF THE NAVIGABLE WATERS OF

BOSTON HARBOR

UNITED STATES DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
NORTHEAST REGION
NEW ENGLAND BASINS OFFICE

MASSACHUSETTS WATER RESOURCES COMMISSION
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WATER POLLUTION CONTROL

APRIL 1, 1969

JOINT REPORT ON POLLUTION
OF THE NAVIGABLE WATERS
OF BOSTON HARBOR

Massachusetts Water Resources Commission
Department of Natural Resources
Division of Water Pollution Control

U. S. Department of the Interior
Federal Water Pollution Control
Administration
Northeast Region
New England Basins Office

April 1, 1969

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SUMMARY AND CONCLUSIONS

INTRODUCTION

As a result of recommendations of the conferees at the conference on the matter of pollution of the navigable waters of Boston Harbor and its tributaries held on May 20, 1968, a technical committee was formed. This technical committee is to be chaired by the chairman of the Massachusetts Resources Commission and also include the Federal chairman of the New England River Basins Commission, and the Regional Director of the Federal Water Pollution Control Administration. The purpose of the committee is to make an evaluation, the scope of which will include but shall not be limited to:

"... (a) A status report of pollution abatement as required by the Division of Water Pollution Control for all municipal and industrial contributors listed in the Massachusetts Standards of Water Quality, including Federal installations as well.

(b) A report of the attainment of the water classifications by several municipal and industrial pollution sources.

(c) The delineation of an overall plan to control the dumping of garbage or refuse along the shores and in the harbor.

(d) A program to improve dump sites and correct the problem of sunken vessels, deteriorating piers and debris.

> the evaluation includes data on reports on:
> Pollution abatement, water classifications,
controlled dumping of garbage; improved
dump sites of sunken vessels; laws to
improve oil pollution and wastes from watercraft,
and Federal installation treatment works.

(e) Investigation of suitable Federal and State laws to control oil pollution and wastes from watercraft.

(f) Study of the Deep Tunnel Proposal from a water quality standpoint as well as consideration of the most feasible means of financing such a project.

(g) Plans to assist Federal authorities in the implementation of treatment works from Federal installations..."

A subcommittee was formed composed of staff from the Massachusetts Division of Water Pollution Control and the New England Basins Office, Federal Water Pollution Control Administration. The purpose of the subcommittee was to make a technical evaluation of issues mentioned in the Introduction Section, items (a) through (g). This report is directed to the full technical committee.

STUDY AREA

Boston Harbor has been described by the Massachusetts Division of Water Pollution Control as the area or body of water inside or west a line drawn from Point Allerton in Hull to the Boston Light to the Southeastern point of Deer Island, as shown in Figure 1 (follows Appendix G). This area includes Boston Inner Harbor, Boston Outer Harbor, Winthrop Harbor, Dorchester Bay, Quincy Bay, Hingham Bay and Hull Bay.

TECHNICAL EVALUATION

The findings of the subcommittee are summarized below:

Item (a)

The status report on pollution abatement in Boston Harbor is shown in Table 1 as recommended by the Massachusetts Division of Water Pollution Control. Status of pollution abatement in Boston Harbor by Federal installations is shown in Table 2.

Item (b)

Boston Harbor has three different water classifications. Class SA waters are located in Quincy Bay and Hingham Bay. Class SB waters are located throughout the rest of the harbor with the exception of the Inner Harbor area which is Class SC. Water quality classifications in certain area are not being met in Boston Harbor. A discussion of the attainment of the water classification in each section of the harbor is as follows:

Inner Harbor

The Inner Harbor does not meet the Class SC classification due primarily to combined sewer overflows in the area. The water does not meet the criteria bacteriologically, chemically or biologically.

Winthrop Harbor

Class SB standards are not being met in Winthrop Harbor both in the bacteriological and biological categories. The median coliform count per 100 ml was 3800 in Station BA and considerably greater closer to the Deer Island outfall.

TABLE 1

POLLUTION ABATEMENT PLAN

SOURCE	TYPE OF TREATMENT NEEDED	DATE OF COMPLETION
Deer Island Waste Water Treatment Facility	Additional Chlorination Capacity	April 1, 1969
Nut Island Waste Water Treatment Facility	Additional Chlorination Capacity	April 1, 1969
MDC Winthrop Sewage Bypass	Tie to Deer Island Facility	July, 1969
Hull	Primary Treatment Facility	March, 1971
Tidegates in the City of Boston	Repair of Gates	May, 1971
Calf Pasture Pumping Station and City of Boston's Moon Island Facility	Tie to MDC Sewerage System	March, 1972
Monsanto-Everett	Tie to MDC Sewerage System	October, 1969

TABLE 2

FEDERAL INSTALLATIONS--BOSTON HARBOR

NAME	AGENCY	LOCATION	QUANTITY IN G.P.D.		TREATMENT	COMMENTS
			SANITARY	INDUSTRIAL		
Boston Army Base	Army	Boston	100,000		Boston City Sewer	
Family Housing Area	Army	Winthrop	2,960		Winthrop City Sewer	
Nike Ajax Site B-36	Army	Hull	6,000		Septic tank & Chlor. Discharge to Hingham Bay	A sand filter has been designed. Construction will be completed by November 1969.
Windmill Point Lifeboat Sta.	Coast Guard	Hull	640		Hull Town Sewer	
Point Allerton Sta.	Coast Guard	Hull	1,920		Hull Town Sewer	
Deer Island Light Sta.	Coast Guard	Boston	240		None	Scheduled to be automated by May 1970.
Boston Station	Coast Guard	Boston	20,000		Boston City Sewer	

TABLE 2 (CONTINUED)

NAME	AGENCY	LOCATION	QUANTITY IN G.P.D. SANITARY	QUANTITY IN G.P.D. INDUSTRIAL	TREATMENT	COMMENTS
Base Boston	Coast Guard	Boston		18,000	None	Cooling water for machinery and dynamometer.
Base Boston	Coast Guard	Boston.	150		None	Two urinals on pier discharging directly to Boston Harbor. Plans are underway to eliminate by 1970.
Base Boston Vessels in Port	Coast Guard	Boston Harbor	22,000		None	Construction of a shore sewer line to collect sanitary wastes from berthed ships is scheduled to begin by March 1970.
Naval Hospital	Navy	Chelsea	102,000		Boston City Sewer	
Naval Shipyard	Navy	Boston	345,000		Boston City Sewer	
Naval Shipyard	Navy	Boston		1,420,000	None	Cooling water
				277	None	A program has been implemented to eliminate the discharge of all industrial wastes to Boston Harbor.

TABLE 2 (CONTINUED)

NAME	AGENCY	LOCATION	QUANTITY IN G.P.D.		TREATMENT	COMMENTS
			SANITARY	INDUSTRIAL		
Naval Shipyard	Navy	Boston	4,000		None	Toilets on Piers 4 & 6 discharging directly to Boston Harbor. Interim measures are being implemented and permanent plans are being developed to eliminate this discharge.
South Boston Naval Annex	Navy	Boston	9,000		Boston City Sewer	
Dry Docks Naval Shipyard & Naval Annex	Navy	Boston	33,000		None	Wastes are discharged from Dry Dock 2, Naval Shipyard and Dry Dock 3, Naval Annex directly to Boston Harbor. A consulting engineer has been retained to complete final plans to eliminate this discharge.
Naval Shipyard & South Boston Naval Annex (Berthed Ships)	Navy	Boston Harbor	40,500		None	Testing of shipboard wastewater treatment facilities now taking place.
Naval Station	Navy	Boston	49,500		Boston City Sewer	

TABLE 2 (CONTINUED)

NAME	AGENCY	LOCATION	QUANTITY IN G.P.D. SANITARY	QUANTITY IN G.P.D. INDUSTRIAL	TREATMENT	COMMENTS
Squantum Gardens	Navy	Squantum Point	34,800		Quincy City Sewer	
Naval Terrace	Navy	Squantum Point	10,100		Quincy City Sewer	
Boston Motor Pool	G.S.A.	Boston	400		Boston City Sewer	
U.S. Appraisers Stores	G.S.A.	Boston	5,200		Boston City Sewer	
G.S.A. Stores	G.S.A.	Hingham	2,100		Hingham Town Sewer	
Food & Drug Admin.	H.E.W.	Boston	3,600		Boston City Sewer	

The high bacterial counts may be attributed to the sewage overflows from the Winthrop area, inadequate chlorination of the Deer Island waste effluent and the Nut Island sludge which, during the sampling period, discharged without regard to the tidal cycle.

Boston Outer Harbor

The Deer Island sewage and sludge outfalls and the Nut Island sludge outfall are located in this area.

Although the Outer Harbor is classified SB, certain areas around outfalls will be considered "mixing zones" and thereby be exempt from the Class SB classification requirements.

The bacterial and biological quality of the Outer Harbor did not meet the SB water quality criteria.

More effective chlorination of the Deer Island sewage effluent is expected to improve the bacterial quality in this area. Release of sludge from both Deer Island and Nut Island only during the outgoing tide will also improve water quality in the Outer Harbor.

It is interesting to note that all samples collected in the Outer Harbor north of Spectacle Island showed oxygen values above 6.5 mg/l and therefore meets the dissolved oxygen requirement for Class SB waters.

Dorchester Bay

The median coliform count per 100 ml in Dorchester Bay was 730 or 30 more than the maximum allowable count of 700 for a Class SB water.

The bacterial and biological quality of this water does not meet the established criteria and is undoubtedly influenced by the combined sewers in the Dorchester Bay area along with Deer Island waste treatment facility effluent, Moon Island facility effluent, Neponset River water and waters from Boston Inner Harbor.

Quincy Bay, Hingham Bay and Hull Bay

Except for certain areas related to raw sewage discharges from Hull and effluent from the Nut Island facility the waters of these areas were of good quality and met the assigned chemical and bacteriological classification criteria. It should be noted, however, that the biological criteria were not met.

Some samples in this area showed orthophosphate phosphorus values in excess of the 0.07 maximum limit. Although the average concentrations of phosphorus in most cases were under 0.07 mg/1, this is one parameter requiring future surveillance because of its relationship to algae growths.

Items (c and d)

The Massachusetts Division of Water Pollution Control conducted a survey in 1968 of all types of water pollution in Boston Harbor. During the survey, a great deal of floating debris was observed both in the inner and outer harbors.

Permits for burning of solid waste are issued by the Massachusetts Department of Public Works. The Department also supervises the loading and unloading operations to ensure that all debris falling overboard is retained by "booms" and subsequently removed, thus resulting in improvement of the debris problem.

The Massachusetts Department of Public Works, Division of Waterways has placed before the legislature a bill to authorize the Department to remove dilapidated piers, old barges and other floating debris from the harbor.

The United States Army Corps of Engineers is conducting a debris study in Boston Harbor which started in 1967 and is scheduled for completion in the Summer of 1971. This study will determine the cost, feasibility and economic justification of a program to solve the problem.

Control of dumping of garbage and refuse, except as mentioned above, is the primary responsibility of the local board of health in most Commonwealth cities and towns. The Division of Water Pollution Control's survey showed many areas containing garbage and refuse. Time and resources did not permit the development of an overall plan to control the problem.

Broad authority for oil pollution control has been given to the Massachusetts Division of Water Pollution Control with the passage of amendments to the Massachusetts Clean Waters Act in 1968. The Division now has the power to move immediately to contain and remove oil spills, and costs and expenses may subsequently be recovered from the person responsible for the spill. Rules and Regulations are currently being drafted and will be issued this Spring after a public hearing.

There are three Federal laws that relate to control of oil pollution; The Refuse Act of 1899, The Oil Pollution Act of 1924, and The Oil Pollution Act of 1961.

The Refuse Act of 1899 is administered by the Corps of Engineers. It reads in part, "...it shall not be lawful to throw, discharge or deposit or cause, suffer or procure to be thrown, discharged or deposited, either from or out of any ship, barge or other floating craft of any kind, or from the shore, wharf, manufacturing establishment or mill of any kind, any refuse matter of any kind or description whatever." The term "refuse" as used in the Act has been interpreted by the courts to include oil and other petroleum products.

The Oil Pollution Act of 1924 is administered by the Federal Water Pollution Control Administration. It prohibits "any grossly negligent or willful spilling, leaking, pumping, pouring, emitting, or emptying of oil" from any boat or vessel within territorial waters. The U. S. Congress held hearings recently on legislation to amend the law.

The Oil Pollution Act of 1961, administered by the U. S. Coast Guard, prohibits any discharge or escape of oil or oil mixture from a sea-going vessel of United States Registry or nationality with some exceptions.

Pollution from watercraft is under very general coverage of both State and Federal laws. New legislation being considered by the Congress would amend the Federal Water Pollution Control Act to include discharge from watercraft.

Item (f)

The Deep Tunnel Plan for collecting and disposing of overflows of mixed sewage and storm flows could provide a long term solution to a significant problem of water quality in the Boston Harbor area. It is also a project with major financial implications in a period where serious fiscal problems are being encountered by cities and towns, the State and Federal Government. It should be noted that under current Federal and State water pollution control laws, this project is not eligible for either State or Federal aid, and all costs must be born by the effected communities. Implementation of a vast program such as the Deep Tunnel Proposal might require State and Federal enabling legislation.

Should this plan prove to be the most feasible, the Commonwealth of Massachusetts would suggest that implementation of this vast program would appear to be best financed by congressional authorized civil works project with the greatest percentage of contributions coming from the Federal government and with cost sharing between the five communities, the MDC and the Commonwealth.

Item (g)

Assistance is now being given the Department of Defense as well as the Department of Transportation, U. S. Coast Guard by the Federal Water Pollution Control Administration in regard to the implementation of treatment works at Federal installations (see Table 2).

INTRODUCTION

BACKGROUND

On May 20, 1968, the Secretary of the Interior held a conference in the matter of pollution of the navigable waters of Boston Harbor and its tributaries, involving the Commonwealth of Massachusetts and the Department of the Interior, under the provisions of Section 10 of the Federal Water Pollution Control Act.

The Act authorizes the Secretary of the Interior to call a conference of this type when he finds that substantial economic injury results from the inability to market shellfish or shellfish products in interstate commerce because of pollution subject to abatement under the Federal Act, and action of Federal, State or local authorities.

Conclusions and recommendations of the May 20, 1968 conference are as follows:

"... (1) The waters of Boston Harbor are polluted over some shellfish beds.

(2) This pollution results from the discharge of untreated or inadequately treated wastes from municipalities, industries, combined sewer overflows, tributary streams, Federal installations specifically: Boston Naval Shipyard, Navy ships berthed in Boston Harbor, Coast Guard's Base Boston, Nike Ajax Site B-36 (Hull); watercraft wastes and pollution caused by debris and refuse. As a result, these waters are polluted by bacteria, suspended

solids, nutrients and organic matter causing an oxygen demand.

(3) As a result of the existing or potential pollution of these waters, the Commonwealth of Massachusetts, under the cooperative agreements governing the National Shellfish Sanitation Program, has completely closed some areas for the direct marketing of shellfish and restricted additional areas so that the shellfish must be processed through a depuration plant.

* (4) These closures have caused substantial economic injury resulting from the inability to market shellfish products in interstate commerce.

* (5) The pollution of these navigable waters is subject to abatement under the provisions of Section 10 of the Federal Water Pollution Control Act, as amended.

(6) In some areas, the pollution of these waters has resulted in an unsightly appearance, the excessive growth of aquatic plants, objectionable odors, sludge deposits and limited use of the waters for recreational bathing, boating and esthetic enjoyment.

(7) The State Water Pollution Control Agency has taken appropriate action to date under State law to abate pollution. The delays in abating the pollution are due to the very complicated nature of the problem.

*These conclusions were not agreeded upon by the Commonwealth of Massachusetts conferee.

(8) The conferees agreed that a technical committee be appointed to be chaired by the chairman of the Massachusetts Resources Commission, the Federal chairman of the New England River Basins Commission, and the Regional Director of the Federal Water Pollution Control Administration. This committee will be a technical committee and shall be empowered to appoint subcommittees to enlist and support members. They will make an evaluation and the scope of the evaluation will include, but shall not be limited to:

(a) A status report of pollution abatement as required by the Division of Water Pollution Control for all municipal and industrial contributors listed in the Massachusetts Standards of Water Quality, including Federal installations as well.

(b) A report of the attainment of the water classifications by several municipal and industrial pollution sources.

(c) The delineation of an overall plan to control the dumping of garbage or refuse along the shores and in the harbor.

(d) A program to improve dump sites and correct the problem of sunken vessels, deteriorating piers and debris.

(e) Investigation of suitable Federal and State laws to control oil pollution and wastes from watercraft.

(f) Study of the Deep Tunnel Proposal from a water quality standpoint as well as consideration of the most feasible means of financing such a project.

(g) Plans to assist Federal authorities in the implementation of treatment works from Federal installations...."

This report presents the status of the evaluation of the above points raised in item (8) by the conferees on May 20, 1968.

Preparation of this report was a joint effort by the Massachusetts Division of Water Pollution Control and the Federal Water Pollution Control Administration, Northeast Region, New England Basins Office.

DESCRIPTION OF AREA

Boston Harbor has been described by the Massachusetts Division of Water Pollution Control as the body of water west of a line drawn from Point Allerton in Hull to the Boston Light House to the southeastern point of Deer Island, as shown in Figure 1 (follows Appendix G). This area includes Boston Inner Harbor, Boston Outer Harbor, Winthrop Harbor, Dorchester Bay, Quincy Bay, Hingham Bay and Hull Bay.

Boston Harbor receives the drainage from four major coastal streams--the Mystic, Charles, Neponset and Weymouth Fore Rivers; the entire waterfront and minor tributary areas extending from Winthrop to Hull; and all of the municipalities which are part of the Metropolitan District Commission sewerage system. This system drains 664 square miles with a population of approximately 2 million, and lies completely within the Commonwealth of Massachusetts. It contains all of forty-eight cities and towns and significant portions of eleven others.

HYDROGRAPHY

Boston Harbor, which opens into Massachusetts Bay, is approximately fifty square miles in area, when all the tidal area is considered. More than three-quarters of the harbor has a mean low water (MLW) depth of ten feet or less. Two major shipping channels serve Boston Harbor: President Roads, with an MLW depth of forty feet, and Nantasket Roads, with an MLW depth of thirty feet. There are approximately one and a half miles of effective harbor connections with Massachusetts Bay.

The maximum current in the main channels is 2.0 knots, occurring near Deer Island Light three hours after the beginning of flood tide. In terms of flow and circulation, the harbor may be divided into a northern section comprised of President Roads, Dorchester Bay and Inner Harbor and a southern section comprised of Quincy Bay, Hingham Bay and Hull Bay. In both sections, the tidal fluctuation is approximately nine-and-a-half feet.

On a volume-flow relationship, the residence time is slightly under two complete tidal cycles--approximately twenty-four hours. However, the harbor does not respond in this manner and much of the water is not completely flushed out every twenty-four hours, for there are many sections where backwaters and poor circulation exist.

The total flow from the tributary streams ranges from 20 cubic feet per second (cfs) to 1,800 cfs, averaging 350 cfs during the summer. This flow is very low compared to the tidal interchange of salt water, which averages 320,000 cfs for a six-hour period.

Annual precipitation for the area averages forty-three inches, approximately sixty-five percent of which occurs in the winter and spring.

SOURCES OF POLLUTION

Boston Harbor receives the discharge of municipal wastes from 1.5 million people served by the Metropolitan District Commission (MDC) sewerage system and municipal wastes from parts of Hull and Boston. Degradation of water quality in the harbor also results from industrial waste discharges; combined sewer overflows; streams tributary to the harbor; Federal facilities discharges; watercraft wastes; debris and refuse contributed by barging operations, shoreline refuse dumping, and dilapidated piers and wharves; and other sources.

MUNICIPAL WASTES

The greatest source of pollution to the waters of Boston Harbor is the discharge of municipal wastes. From May through September, 1968, the MDC discharged an average of 387 million gallons per day (mgd) of sewage receiving primary treatment with chlorination. This includes 100 mgd from the Nut Island waste water treatment facility and 287 mgd from the Deer Island waste water treatment facility. Boston's Long Island Hospital discharges, on the west side of Long Island, 0.3 mgd of sewage which receives primary treatment with chlorination.

An average of 6 mgd of untreated sewage was discharged from the Winthrop area at Deer Island. The City of Boston discharged an average of 18 mgd of untreated sewage on the outgoing tide from the holding tanks on Moon Island. The Town of Hull which does not yet have a waste water treatment plant discharged an undetermined quantity of untreated sewage at three locations into Boston Harbor and the Weir River.

Nut Island Waste Water Treatment Facility

The South Metropolitan system serves twenty cities and towns, listed in Table 3, and transports the waste to the Nut Island waste water treatment facility, which provides primary treatment and chlorination in this well operated facility. Since late Fall of 1968, digested sludge is discharged on the outgoing tide. During the Summer of 1968, the average volume of sewage entering the Nut Island facility was 100 mgd. Approximately 30 percent of the biochemical oxygen demand is removed through the settling process. The treated sewage is discharged through four five-foot diameter outfalls as shown in Figure 2. Two outfalls, at a depth of thirty feet, extend 6,000 feet from the plant; the third outfall extends 1,400 feet from the plant at a depth of twenty feet. The fourth emergency offshore outfall extends 470 feet from the plant. Digested sludge is discharged through a twelve-inch, 4.2 mile pipe in the President Roads area.[14]

Approximately 50 tons per day of suspended solids were discharged from the Nut Island waste water treatment facility during the survey period. The sludge discharge contributes approximately 35 percent of the 50 tons of suspended solids.

Deer Island Waste Water Treatment Facility

Twenty-five communities contribute waste to the North Metropolitan system as indicated in Table 3. The average influent to Deer Island waste water treatment facility from May through September, 1968, was 287 mgd. The MDC exerted great effort during this period in an attempt to get the plant to operate satisfactorily.

TABLE 3

COMMUNITIES DISCHARGING SEWAGE TO THE METROPOLITAN DISTRICT COMMISSION SEWERAGE FACILITIES

System	Communities	
North Metropolitan System -- (To Deer Island)	Arlington Bedford Belmont Boston* Brookline* Burlington Cambridge Chelsea Everett Lexington Malden Medford Melrose	Newton* Reading Revere Somerville Stoneham Wakefield Waltham Watertown Wilmington Winchester Winthrop Woburn
South Metropolitan System -- (To Nut Island)	Ashland Boston* Braintree Brookline* Canton Dedham Framingham Hingham Milton Natick	Needham Newton* Norwood Quincy Randolph Stoughton Walpole Wellesley Westwood Weymouth

*Discharges to both systems.

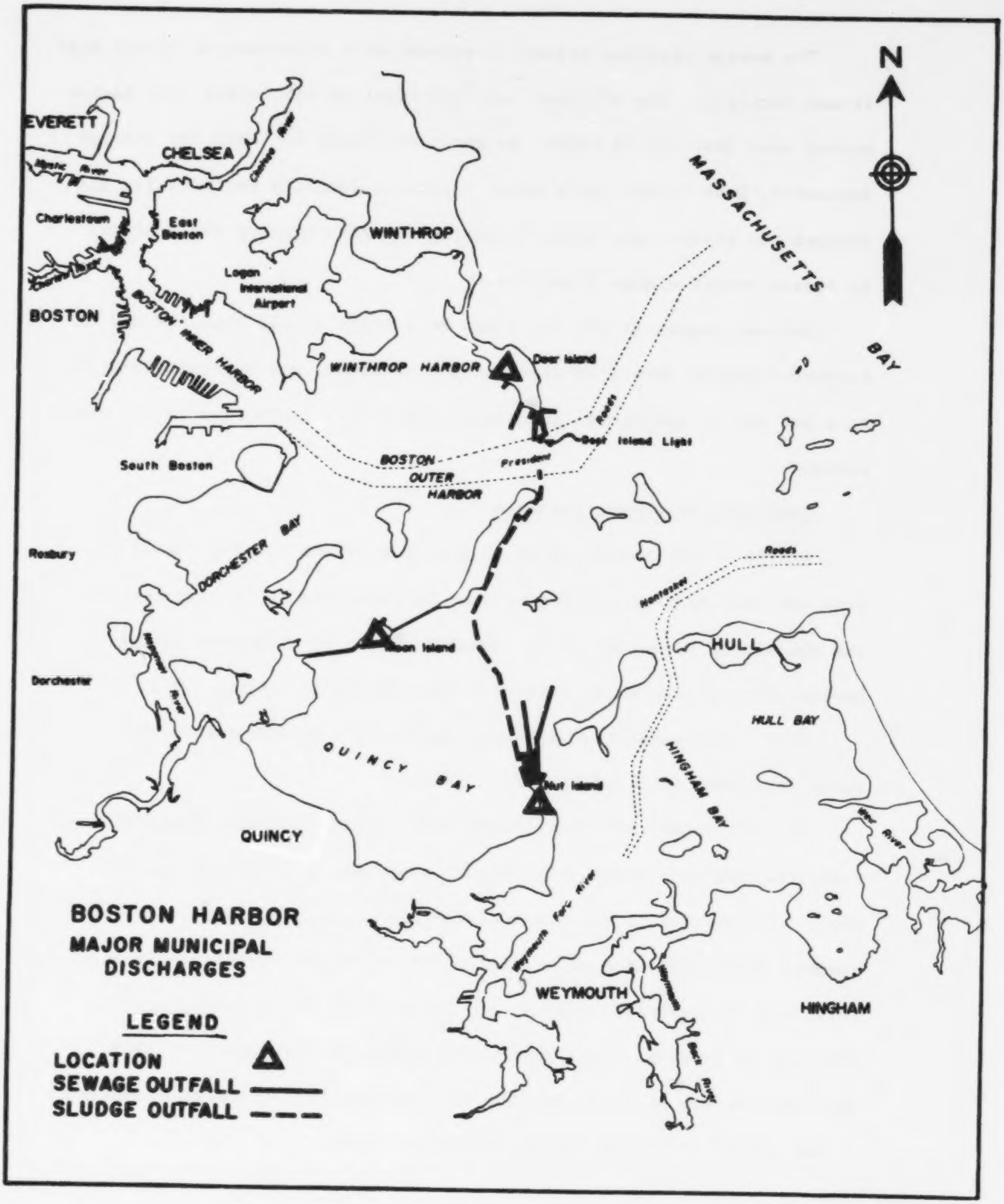

N
EVERETT
CHELSEA
Mystic River
Chelsea River
Charlestown
East Boston
WINTHROP
MASSACHUSETTS BAY
Logan International Airport
Charles River
BOSTON
BOSTON INNER HARBOR
WINTHROP HARBOR
Deer Island
Roads
Deer Island Light
President
BOSTON OUTER HARBOR
South Boston
Roxbury
DORCHESTER BAY
Roads
Nantasket
Moon Island
HULL
Dorchester
River
HULL BAY
QUINCY BAY
HINGHAM BAY
Nut Island
QUINCY
Weir River
Weymouth Fore River
BOSTON HARBOR
MAJOR MUNICIPAL
DISCHARGES
WEYMOUTH
Weymouth Back River
HINGHAM
LEGEND
LOCATION △
SEWAGE OUTFALL ———
SLUDGE OUTFALL — — —

FIGURE 2

The sewage receives primary treatment with chlorination at the Deer Island facility. The effluent from the plant is discharged into Boston Harbor near Deer Island Light, as shown in Figure 2. From May through September, Deer Island waste water treatment facility periodically discharged raw sludge (see Table 4) during digester startup while trying to effect proper sludge digestion.

Between August 12 and 15, 1968, an average of 113 tons per day of suspended solids were discharged in the effluent, and approximately 56 tons per day of additional suspended solids were discharged in the raw sludge.

Pollution Abatement Schedule

BOSTON - Raw sewage pumped to the Moon Island holding facility from the Calf Pasture Pumping Station is scheduled to be diverted to the MDC system by March, 1972. Rehabilitation of tidegates in the Boston sewerage system is scheduled for completion by May, 1971.

HULL - Implementation schedule calls for completion of a waste water treatment facility by March, 1971.

MDC NUT ISLAND AND DEER ISLAND WASTE WATER TREATMENT FACILITIES - Modifications on present chlorination equipment and the purchase of additional units will greatly increase disinfection capability at both plants. More effective chlorination will commence shortly after April 1, 1969, and the bacterial quality of the water in the Winthrop area is expected to improve. This will be evaluated in the Summer of 1969. The Commonwealth of Massachusetts is requiring year-round chlorination of the sewage effluents commencing April, 1969.

TABLE 4

DEER ISLAND WASTE WATER TREATMENT FACILITY
SLUDGE DISPOSAL

Date	Comment
5/15/68 - 5/31/68	All raw sludge being pumped to digesters as collected. No raw sludge to sea disposal.
6/1 - 6/30	Approximately 50 percent raw sludge bypass; average of 104,000 gallons of thickened raw sludge added to digesters daily.
7/1 - 7/31	Continue approximately a 50 percent raw sludge bypass, average of 103,000 gallons of thickened raw sludge added to digesters daily.
8/1 - 8/8	All raw sludge bypassed as collected -- approximately 200,000 gallons per day.
8/8	Secure raw sludge bypassing.
8/9 - 9/9	All raw sludge being added to #3 digester as collected (approximately 244,000 gallons per day) - no raw sludge to sea disposal.
9/10	Begin gradual emptying of #3 digester to sea on ebb tide.
9/10 - 9/30	All raw sludge being added to #3 digester - no raw sludge to sea disposal.

*Extracted from MDC letter to Massachusetts Department of Natural Resources, dated November 18, 1968.

The Squantum Pumping Station will be connected to the MDC sewerage system at Nut Island.

WEYMOUTH-HINGHAM-QUINCY - These municipalities are in the MDC sewerage system.

WINTHROP - The sewage from the Winthrop area will be tied into the Deer Island treatment facility by the Summer of 1969.

GENERAL - The 102 outfalls found during the 1968 Boston Harbor shoreline survey will be sampled and evaluated commencing in the Spring of 1969. Outfalls containing sewage or other pollutants will be referred to the respective municipalities for corrective action.

INDUSTRIAL WASTES

It appears that the majority of the industries in the Boston area discharge to municipal sewerage systems. Complete listings of sources of industrial waste discharging directly to the waters of Boston Harbor are not available. Partial listings are in various stages of development by Federal, State and local agencies. One exception is the industrial wastes from Monsanto, in Everett, which are scheduled for discharge to the MDC sewerage system by October, 1969.

COMBINED SEWER OVERFLOWS AND SEWAGE OUTFALLS

Portions of many of the cities and towns in the Boston Harbor drainage basin have combined sewer systems. During periods of heavy rainfall, when major interceptors reach their capacity, the local sewers overflow directly into the harbor and tributary streams. In some instances, raw sewage overflows occur during normal dry weather flow as a result of lack of maintenance of overflow structures. There are more than 100 points of sewer relief in the Boston area which produce a significant bacterial, grease, solids and organic load in wet weather.

Within the scope of the Boston Harbor Pollution Survey, 102 combined sewer overflows and sewage outfalls were found. Not included in these are individual outfalls, industrial effluents or boiler discharges. The number of sewer overflows and/or sewage outfalls listed by town or city are tabulated in Table 5.

No determination as to flow was attempted at any of the outfalls or overflows because they were partially submerged or were not flowing at the time of examination. A sewer sampling program to be conducted by the Massachusetts Division of Water Pollution Control is planned for the Spring and Summer of 1969. Samples will be collected for chemical and bacterial analyses.

TRIBUTARY STREAMS

The Chelsea, Mystic, Charles, Neponset and Weymouth Fore Rivers are severely degraded before they enter Boston Harbor. The Charles, Neponset and Mystic Rivers are the greatest pollution contributors. Combined sewer overflows constitute a major source of pollution to the tributaries. Significant amounts of oil are added to the harbor from the Chelsea, Mystic and Weymouth Fore Rivers, which are major commercial waterways with many tank farms located along their shores.

FEDERAL INSTALLATIONS

Executive Order 11288 requires heads of Federal departments, agencies and establishments to provide leadership in the national effort to improve water quality through the prevention, control and

TABLE 5

LOCATION OF SEWER OUTFALLS

Location	Number of Outfalls
Hull	11
Hingham	1
Weymouth	3
Quincy	7
Boston	
Neponset River	6
Dorchester/South Boston	8
Inner Harbor (S. Boston to E. Boston, excluding rivers)	40
Charles River (to Watertown Arsenal)	18
Little Mystic Channel	1
Mystic River (to Malden Bridge)	1
Chelsea Creek	4
Belle Isle	1
Winthrop	1
Total	102

abatement of water pollution from Federal activities in the United States. The Order requires that the Secretary of the Interior provide the necessary review, coordination and technical advice for all Federal departments, agencies and establishments. The Federal installations, in turn, are required to cooperate with the Secretary, State and interstate agencies, and municipalities, insofar as practicable and consistent with the interests of the United States and within available appropriations. Water pollution control requirements must be considered and included in the initial stages of planning for each new installation or project. Phased and orderly plans for installing water pollution abatement facilities at existing installations must be developed and periodically revised as required. The Secretary of the Interior has assigned the responsibility of implementing the Executivy Order to the Federal Water Pollution Control Administration.

The Federal installations in the Boston Harbor area are listed in Table 6. Also included in this table are the present sanitary and industrial waste flows and their disposition at each installation. A brief description of the waste disposal practices of the major sources of sanitary and industrial wastes from Federal installations follows:

Boston Naval Shipyard

All sanitary wastes from the Boston Naval Shipyard (Charlestown) shore facility (average flow 0.3 mgd) are discharged to the Boston sanitary sewer system. Cooling water (average flow 1.4 mgd) is discharged to Boston Harbor. A program has been implemented to eliminate the discharge of all industrial wastes from Boston Harbor. A wheelabrator unit is being installed to eliminate the need for some of the acids in

TABLE 6

FEDERAL INSTALLATIONS--BOSTON HARBOR

NAME	AGENCY	LOCATION	QUANTITY IN G.P.D. SANITARY	QUANTITY IN G.P.D. INDUSTRIAL	TREATMENT	COMMENTS
Boston Army Base	Army	Boston	100,000		Boston City Sewer	
Family Housing Area	Army	Winthrop	2,960		Winthrop City Sewer	
Nike Ajax Site B-36	Army	Hull	6,000		Septic tank & Chlor. Discharge to Hingham Bay	A sand filter has been designed. Construction will be completed by November 1969.
Windmill Point Lifeboat Sta.	Coast Guard	Hull	640		Hull Town Sewer	
Point Allerton Sta.	Coast Guard	Hull	1,920		Hull Town Sewer	
Deer Island Light Sta.	Coast Guard	Boston	240		None	Scheduled to be automated by May 1970.
Boston Station	Coast Guard	Boston	20,000		Boston City Sewer	

TABLE 6 (CONTINUED)

NAME	AGENCY	LOCATION	QUANTITY IN G.P.D. SANITARY	QUANTITY IN G.P.D. INDUSTRIAL	TREATMENT	COMMENTS
Base Boston	Coast Guard	Boston		18,000	None	Cooling water for machinery and dynamometer.
Base Boston	Coast Guard	Boston	150		None	Two urinals on pier discharging directly to Boston Harbor. Plans are underway to eliminate by 1970.
Base Boston Vessels in Port	Coast Guard	Boston Harbor	22,000		None	Construction of a shore sewer line to collect sanitary wastes from berthed ships is scheduled to begin by March 1970.
Naval Hospital	Navy	Chelsea	102,000		Boston City Sewer	
Naval Shipyard	Navy	Boston	345,000		Boston City Sewer	
Naval Shipyard	Navy	Boston		1,420,000	None	Cooling water
				277	None	A program has been implemented to eliminate the discharge of all industrial wastes to Boston Harbor.

TABLE 6 (CONTINUED)

NAME	AGENCY	LOCATION	QUANTITY IN G.P.D. SANITARY	QUANTITY IN G.P.D. INDUSTRIAL	TREATMENT	COMMENTS
Naval Shipyard	Navy	Boston	4,000		None	Toilets on Piers 4 & 6 discharging directly to Boston Harbor. Interim measures are being implemented and permanent plans are being developed to eliminate this discharge.
South Boston Naval Annex	Navy	Boston	9,000		Boston City Sewer	
Dry Docks Naval Shipyard & Naval Annex	Navy	Boston	33,000		None	Wastes are discharged from Dry Dock 2, Naval Shipyard and Dry Dock 3, Naval Annex directly to Boston Harbor. A consulting engineer has been retained to complete final plans to eliminate this discharge.
Naval Shipyard & South Boston Naval Annex (Berthed Ships)	Navy	Boston Harbor	40,500		None	Testing of shipboard wastewater treatment facilities now taking place.
Naval Station	Navy	Boston	49,500		Boston City Sewer	

TABLE 6 (CONTINUED)

NAME	AGENCY	LOCATION	QUANTITY IN G.P.D. SANITARY	QUANTITY IN G.P.D. INDUSTRIAL	TREATMENT	COMMENTS
Squantum Gardens	Navy	Squantum Point	34,800		Quincy City Sewer	
Naval Terrace	Navy	Squantum Point	10,100		Quincy City Sewer	
Boston Motor Pool	G.S.A.	Boston	400		Boston City Sewer	
U.S. Appraisers Stores	G.S.A.	Boston	5,200		Boston City Sewer	
G.S.A. Stores	G.S.A.	Hingham	2,100		Hingham Town Sewer	
Food & Drug Admin.	H.E.W.	Boston	3,600		Boston City Sewer	

the tank cleaning operation. The wheelabrator unit will be in operation by August 1969. Seventeen gallons per day will be collected in holding tanks to be picked up by commercial tank truck. The remaining 260 gallons per day will ne neutralized and discharged to the Boston City Sewer system. The implementation of the two plans is scheduled for November 1969.

At Piers 4 and 6 there is an existing system to collect the wastes from the toilets and discharge them to the Boston City Sewer system. However, this collection system freezes during cold weather. As an interim measure the toilets will be re-connected to this system.

A program is being initiated to make the collection system operational year round or to develop another system to eliminate this discharge to the Harbor.

Dry Docks - Naval Shipyard & Naval Annex

A consulting engineer has been retained to design sewage collection systems and pumping stations to collect the wastes from the dry docks and discharge them to the Boston City Sewer system. The final design for these facilities is scheduled for completion by August 1969. Construction of this facility is scheduled in FY 1970.

South Boston Naval Annex

All sanitary wastes from the shore facility (average flow 9,000 gallons per day) are discharged to the Boston sanitary sewer system.

Navy Ships Berthed in Boston Harbor

All Naval ships berthed in the Harbor discharge sanitary wastes without treatment. The total flow discharged varies with the size and number of ships in port but is estimated to average 40,000 gallons per day. The Navy is engaged in a program to abate pollution from its vessels, and as part of this program, has installed a treatment device on board a destroyer based in Boston. This device is currently undergoing testing and evaluation.

Coast Guard's Base Boston

The Coast Guard is negotiating to retain an engineering consultant to complete the final design of a dockside severage collection system to collect wastes from urinals on the piers and ships berthed in the Harbor, and discharge them to the Boston sanitary sewer system. The construction contract is scheduled to be awarded by March 1970.

Deer Island Light Station

This station has been scheduled to be automated by May 1970. Due to insufficient funds, there has been slippage in some of the scheduled dates for automating light stations.

If the schedule for automating this station is delayed beyond May 1970, an interim measure, such as an incinerator toilet or a macerator-chlorinator, will be installed so that this installation will comply with Executive Order 11288.

Nike Ajax Site B-36 (Hull)

Six thousand gallons per day of sanitary wastes are passed through a septic tank and chlorinated before discharge to the Harbor.

A pump station and subsurface sand filter has been designed for this system. When these new facilities are added to the system, the wastes will flow from the septic tank to the pump station, then pumped to the sand filter and chlorinated before discharge to the Harbor. Construction of these facilities is scheduled to be complete by

November 1969.

When this system is complete, it will be in conformance with Executive Order 11288.

WATERCRAFT WASTES

The pollution from watercraft in the Harbor is a significant factor in the overall pollution picture. The problem of pollution from watercraft is complex because at any given moment, pollution may occur at any point along the path of a vessel. While the shellfish and bathing areas may be remote from the channels used by government and commercial vessels, pleasure craft moving at will may suddenly impose a load of raw sewage on the shellfish and bathing areas.

The volume of raw sewage being discharged from U. S. Government vessels is significant. In most cases, this raw sewage was discharged to the Inner Harbor.

Statistics show that approximately 2,000 major cargo vessels and tankers enter the Boston Harbor annually. The number of smaller commercial vessels, including fishing trawlers, is estimated to be approximately 1,000, with most of these being in the harbor daily or at frequent intervals. Testimony presented at the Boston Harbor Conference on May 20, 1968 pointed out that there are 35 private yacht clubs and 32 marinas in the Boston Harbor that provide accommodations for approximately 5,000 private boats.

Recreational boating activity is centered in waters also used for bathing and recreational fishing. As boating use in the Harbor increases, greater pollution will result, unless steps are taken to prevent raw sewage discharges.

Federal Laws

Federal Laws concerning the discharge of wastewater from vessels are very general in nature and contain no specific reference to watercraft wastes. New legislation is currently being considered by the U.S. Congress.

Research and Development funds are now being used on various projects to develop several methods of practical treatment for watercraft wastes.

State Laws

Under the provisions of the Massachusetts Clean Waters Act, the Division of Water Pollution Control has authority to cause the abatement of pollution of the waters of the Commonwealth by the discharge of sewage and other waste waters from watercraft. However, because watercraft cruise in waters of adjacent states, this Division believes that there should be uniform interstate requirements and regulations. During the last two years, the Commonwealth, as a member of the New England Interstate Water Pollution Control Commission, has been meeting with the boat pollution committees of the Commission in an attempt to attain uniform requirements within New England waters. The findings and recommendations of this Commission are to be published in the near future. It is agreed by all concerned that some means of watercraft waste treatment or control must be developed which will either effectively eliminate the discharge of waste (no effluent device) or which will adequately treat the waste so as to render it acceptable for discharge to the surrounding waters, (controlled effluent device). The acceptability of such devices must not only be related to the equipment itself, but also on the availability of maintenance, repair and replacement service.

In 1966, the Commonwealth was a conferee at the National Conference on watercraft waste disposal. The conference was convened as a result of resolutions adopted by water pollution control agencies calling for leadership in the development of test procedures for sewage and waste treatment devices, and for the cooperation in the development of an acceptance program for these devices through a national testing and evaluation laboratory.

It is estimated that within a short period of time, the Commonwealth will then be in a position to recommend legislation relative to the discharge of sewage from watercraft.

DEBRIS AND REFUSE

State Study

In 1968, the Division of Water Pollution Control conducted a survey of all types of water pollution in Boston Harbor, during which a great deal of floating debris was observed both in the Inner and Outer Harbors. This debris consisted of logs, barrels and large and small pieces of wood. The refuse, mostly on the shoreline, consisted of plastic, waste garbage, rubbish, cans and bottles.

Many areas, especially in the City of Boston have large numbers of abandoned dilapidated piers. Many of these piers have fallen into the water and debris from them has drifted into the navigable channels. This form of debris can be observed throughout the Inner and Outer Harbor.

Also of concern are the abandoned barges, either completely or partly submerged. These barges contribute oil, grease and miscellaneous debris which eventually loosen and break away.

Two areas located on the Mystic and Malden Rivers serve as collection sites for debris. This material is loaded onto barges and towed to the Outer Harbor and burned. After completion of the burning operation, the barge is towed back to the original site and unloaded. The operation located on the Malden River has been terminated and no barges from this operation are used for burning. The collection site located on the Mystic River had ceased operation but has recently been started again. Burning at the present time is carried out only at the Green Island site unless weather conditions are unfavorable; then burning takes place at Calf Island.

The Massachusetts Department of Public Works issues permits for burning. It also supervises the loading/unloading operations to ensure that all debris falling overboard is retained by "booms" and subsequently removed.

Since surveillance techniques have been employed by the Massachusetts Department of Public Works and the Massachusetts Department of Natural Resources, there has been a significant improvement in the barge burning operations over the past year.

A list of sources of solid waste pollution found during the 1968 survey are shown in Tables 7 and 8.

Federal Study

The Corps of Engineers is conducting a debris study in Boston Harbor which started in 1967 and is scheduled for completion in the Summer of 1971. A complete outline of the debris study is presented in Appendix G.

TABLE 7

LOCATION OF RUBBISH, DEBRIS AND DUMPS

Hull - Hull Dump

Quincy - Town River - junk yard - west of Hale point

Quincy - Long Island - rubbish and debris - rear of boiler complex

Quincy - Neponset River - rubbish dump - end of Spruce Street

Quincy - Neponset River - rubbish dump - end of Newbury Street

Quincy - Neponset River - Boston Engineering and Motor Sales

Quincy - Neponset River - Hancock Paint & Varnish Co., - rubbish and debris

Quincy - Thompson Is. - rubbish dump - south end of island

Boston - Neponset River - dump - behind Neponset Drive-In

Boston - Fort Point Channel - rubbish and debris - entire length of channel

Boston - Reserved Channel - rubbish and debris - entire length of channel

Boston - Atlantic Avenue - Aquarium Restaurant - rubbish and debris in rear

Boston - Atlantic Avenue/Commercial Street - rubbish and debris along entire length

Boston - Mystic River - Fournier Marine Corp. - barge burning operation

Boston - Chelsea Creek - entire length - both sides - rubbish, debris, and junk

E. Boston - Eagle Square Area - rubbish dumping

E. Boston - Condor Street area - rubbish dumping

E. Boston - Jeffries Point - rubbish dumping

E. Boston - Border Street area - rubbish dumping

E. Boston - Bennington Street area - rear of MBTA - rubbish and debris dump

Winthrop - Winthrop dump

Winthrop - Duval Industries - rubbish and debris dump in rear

TABLE 8

LOCATION OF ROTTED AND DILAPIDATED PIERS, SUNKEN BARGES

Quincy - Moon Island - rotted piers

Boston - Long Island - rotted piers

Boston - Thompson Island - sunken barge

Boston - Calf Island - sunken barges

Boston - Neponset River - Neponset side - rotted piers - sunken barges

Boston - Freeport St. - rotted and dilapidated piers

Boston - Brewster Island - sunken barges

Boston - Reserved Channel - rotted piers

Boston - Navy Yard - dilapidated piers

Boston - Northern Ave. area - dilapidated piers

Boston - Fort Point Channel - dilapidated piers

Boston - Atlantic Ave./Commercial St. - dilapidated piers

Boston - Charles River - Old Warren St. Bridge - rotted and dilapidated

Charlestown - Little Mystic Channel - rotted piers

Everett - Malden River - rotted piers

Everett - Mystic River - rotted piers

Chelsea - Chelsea Creek - entire length - rotted and dilapidated piers

E. Boston - Chelsea Creek - entire length - rotted and dilapidated piers

E. Boston - Marginal St. area - entire length - rotted and dilapidated piers.

OIL POLLUTION

Approximately 80 percent of the cargo transported through the port of Boston is petroleum products. The discharge of oil and oil materials from watercraft is a serious pollution problem, whether it is an accidental spill or oil waste waters from ballast tanks, bilges or washing operations.

The U. S. Coast Guard reported 28 oil spills in Boston Harbor to the U. S. Army, Corps of Engineers, between September, 1967, and September, 1968. Numerous other small spills occurred which were not reported. Action has been initiated at several levels which promises significant abatement of the oil pollution in Boston Harbor.

The Boston Harbor Pollution Committee was formed in 1965 to clean up the harbor through voluntary action, enforcement of existing laws and additional legislation, if required. Sponsored by the Massachusetts Port Authority, the committee includes Federal, State, city and Metropolitan District Commission representatives as well as concerned industrial and civic organizations. Due to its broadly-based membership, the Harbor Pollution Committee has been and will continue to be a major factor in abating pollution.

The petroleum industry has taken voluntary action through the Massachusetts Petroleum Council to control pollution. The Council includes most of the major oil companies in the area; a Committee on Oil Spills has been established with the council which performs a self-policing function. The Council members also recently purchased a total of 13,250 feet of slickbar plastic booms which are stored in numerous locations throughout Boston Harbor and are available without charge to

Council members, State and Federal agencies for use in containing oil spills. A stockpile of chemicals for cleaning up oil spills is also maintained in a number of terminals.

The equipment and chemicals currently available for dealing with oil spills have, as a rule, been available commercially for only a short time. As new materials continue to be tested, it is anticipated that superior methods for dealing with oil pollution will be developed. All of the concerned organizations are vitally interested in new proposals and continually monitor development in this area.

Research and Development work is now being carried out by both the Commonwealth and Federal employees as well as private consulting firms on oil pollution problems.

State Laws

The Massachusetts Clean Waters Act, passed in 1966, gave the Massachusetts Division of Water Pollution Control broad authority for a pollution control program throughout the Commonwealth. Subsequently, Chapter 648 of the Acts of 1968 amended the Clean Waters Act to specifically broaden the Division of Water Pollution Control's authority in curbing oil pollution and to fund this additional activity. Under this Act, the Division of Water Pollution Control can move immediately to contain and remove oil spills if the quality of water is threatened; costs and expenses may subsequently be recovered from the person responsible for the spill. The Division of Water Pollution Control is preparing a contract to have standby facilities available for performing this oil spill clean-up service. The Division of Water Pollution Control has also been empowered to inspect and license all oil terminals in the Commonwealth; by ordering the replacement of defective hoses and equipment and by regulating terminal operations, many of the minor spills that occur daily should be eliminated. Rules and regulations are currently being drafted and will be issued this Spring after a public hearing.

Federal Laws

As of this date, there are three Federal laws related to oil pollution control.

1. The Refuse Act of 1899, 33 USC 407.
2. The Oil Pollution Act of 1924, as amended, 33 USC 431-437.
3. The Oil Pollution Act of 1961, as amended, 33 USC 1001-1015.

The Refuse Act is administered by the United States Army Corps of Engineers. This Act reads in part "...it shall not be lawful to throw discharge or deposit or cause, suffer or procure to be thrown, discharged or deposited either from or out of any ship, barge or other floating craft of any kind, or from the shore, wharf, manufacturing establishment or mill of any kind, any refuse matter of any kind or description whatever..." The term "refuse" as used in this Act has been interpreted by the courts to include oil and other petroleum products. It applies to U. S. navigable waters, tributaries to these waters and, in addition, to the banks if there is a possibility that they may contribute refuse to the waters which they channel. The maximum penalty which may be levied under this Act is a fine of $2500 and/or a maximum prison term of one year.

The Oil Pollution Act of 1924 is administered by the Federal Water

Pollution Control Administration, Department of the Interior. It prohibits "any grossly negligent or willful spilling, leaking, pumping, pouring, emitting, or emptying of oil" from any boat or vessel. It may be applied to all portions of the sea within the territorial jurisdiction of the United States, all inland waters navigable in fact and their adjoining shore lines. The maximum penalty is $2500 or one year in prison or both. The vessel, as long as it is not a public vessel of the U. S., is liable in "rem" (against property) for up to $10,000.

A revision of the 1924 Oil Pollution Control Act is now before the Congress of the United States. This revision would change the phraseology of the Act so as to make it more enforceable when applied to vessels and to include shore-based facilities and off-shore drilling platforms within its provisions.

The Oil Pollution Act of 1961 is administered by the United States Coast Guard, Department of Transportation. It prohibits any discharge or escape of oil or oily mixture from a seagoing vessel of United States Registry or nationality except:

1. Tankers under 150 G.T.
2. Other vessels under 500 G.T.
3. Ships engaged in the whaling industry
4. Ships temporarily using the Great Lakes
5. Naval ships and auxiliaries

It is applicable in all sea areas within 100 miles from the nearest land. The maximum fine which may be levied is $2500 and/or one year in prison. A public vessel of the United States is not liable for the monetary penalty.

The Federal Water Pollution Control Act, as amended, is another important tool in oil pollution control. The establishment by the States of enforceable water quality standards, applicable to interstate waters, consitutes one of the most effective methods for preventing pollution of a continuing nature.

OTHER SOURCES

Water quality may be adversely affected by a variety of other land and water activities. For instance, urban runoff from streets and parking lots can add significant amounts of organic and suspended materials. The disturbance of bottom muds by dredging operations can result in a resuspension of accumulated organic sludges and silt and the smothering of shellfish.

The City of Boston sewerage system was constructed in the late 1800's. From past experiences in large cities, it is likely that some local sewers, for which there are no records, have never been intercepted and are presently discharging sewage directly to the harbor and tributaries. These sewer outfalls would be in addition to the 102 sewer outfalls listed previously.

GARBAGE AND REFUSE DISPOSAL

In most cities and towns in the Commonwealth, the local board of health has the authority to operate and maintain the solid waste disposal facilities. Upon request of the local board of health, the State Health Department may advise and/or require changes pursuant to proper operation and maintainance. The recommended operating procedure for all dumps and refuse disposal areas is the sanitary landfill method or incineration which would prevent the material from being washed into the water.

The Department of Public Works, Division of Waterways has placed before the legislature a bill to authorize the Department to remove dilapidated piers, old barges, and other floating debris from the harbor. The funding for this work is to come from a portion of the tax collected on gasoline from motor boats in the Commonwealth.

PRESENT WATER QUALITY

INTRODUCTION

To determine the present water quality in Boston Harbor, the Federal Water Pollution Control Administration (FWPCA), the Massachusetts Division of Water Pollution Control (Mass. DWPC) and the Metropolitan District Commission (MDC) cooperated in a limited survey during the summer of 1968. All water samples from Boston Harbor were taken and analyzed by FWPCA.

Samples of the effluents from the two MDC waste water treatment facilities were taken by MDC personnel. Samples from Boston's Moon Island facility were collected by the Massachusetts DWPC. Bacteriological analyses were carried out on all samples by the FWPCA, while all other tests on the effluents conducted by the Massachusetts Department of Public Health's Lawrence Experiment Station Laboratory. The biological survey, conducted by FWPCA, included the identification of the organisms.

Sampling stations in Boston Harbor are listed in the Appendix A and are shown on Figure 1. Individual daily results of all physical, chemical and bacteriological determinations are tabulated in Appendix B. Biological results are also given in the Appendix (Appendix C - Benthic Organisms, Appendix D - Phytoplankton).

BACTERIA

The bacterial indicator organisms used were coliforms, both total and fecal. The membrane filter technique was used during the study in the analyses for the coliform bacteria as outlined in Standard Methods.(1)

The elevated temperature test(11) was used to differentiate the coliforms of fecal origin from the total count.

Resulting data summaries are shown in Table 9. The data for stations BA, BB, BC and BD collected during sampling period No. 1 in May 1968, are summarized separately in Table 9. They are not included in the data obtained from the summer sampling program because of the time lapse between studies. However, the May 1968 data provides an indication of conditions in Boston Harbor when sludge is being collected but not being discharged by the Deer Island facility. Significantly lower coliform densities were noted during this period.

The average coliform densities during the summer of 1968 were about the same or, in some areas, significantly more than the preceding summer. Quincy Bay, however, showed an improvement in water quality over 1967, and met the standard for "SA" classification of the Massachusetts Classification Standards for coastal waters insofar as the coliform density is concerned. Class SA waters have a coliform bacteria per 100 ml limit not to exceed a median value of 70 and not more than 10 percent of the samples shall ordinarily exceed 230 during any monthly sampling period. Class SB waters have a coliform bacteria per 100 ml limit not to exceed a median value of 700 and not more than 2300 in more than 10 percent of the samples during any monthly sampling period. Class SC waters have a coliform bacteria limit of none in such concentrations that would impair any usages specifically assigned to this class.

The waters adjacent to the outfalls at Deer Island may be described as polluted even when the sewage effluent was chlorinated. This

TABLE 9

BOSTON HARBOR
SUMMER - 1968*
Summary of all Coliform Data
Coliforms per 100 ml (MF)

Station	Mean		Median		Range - Total		Range - Fecal	
	Total	Fecal	Total	Fecal	Min.	Max.	Min.	Max.
BB**	610	23	265	21	20	2,700	< 2	68
BC**	1,100	50	610	37	250	6,000	8	150
BD**	350	6	50	4	< 10	3,600	< 2	26
BA**	2,500	49	430	12	< 10	28,000	< 2	520
BA	17,000	1,300	3,800	225	10	265,000	2	16,000
BB	4,600	360	730	86	10	37,000	< 2	4,500
BC	60,000	4,100	5,200	490	10	700,000	2	50,000
BD	1,500	40	240	10	30	17,000	< 2	310
BH-1	710	10	130	8	10	5,500	< 2	24
BH-2	1,000	31	60	6	< 10	6,000	2	200
BH-3	650	4	10	2	< 10	5,600	< 2	12
BH-4	730	< 2	2	< 2	< 10	6,000	< 2	2
BH-5	370	< 2	10	< 2	< 10	3,200	< 2	< 2
BH-6	790	< 2	30	< 2	< 10	6,700	< 2	2
BH-7	960	< 2	10	2	< 10	8,500	< 2	2
BH-8	610	5	10	2	< 10	5,200	< 2	20
BH-9	1,400	32	590	28	60	7,800	6	64
BH-10	750	3	10	2	10	6,300	2	6
BH-11	950	2	30	2	< 10	8,300	< 2	6
BH-12	66	4	60	4	20	110	< 2	8
BH-13	10	< 2	10	< 2	2	20	< 2	< 2
BH-14	9	< 2	10	2	4	10	< 2	< 2
BH-15	8	< 2	10	< 2	< 2	10	< 2	< 2
BH-16	30	3	20	2	< 10	140	< 2	8
BH-17	58	4	43	2	< 10	200	< 2	16
BH-18	2,100	150	1,000	10	100	8,000	10	< 1,000
BH-19	24	4	10	2	< 10	68	< 2	12
BH-20	81	11	60	4	< 10	250	< 2	52
BH-21	270	16	210	6	20	720	2	62
BH-22	33	2	10	2	< 10	150	< 2	4
BH-23	37	4	40	2	< 10	72	< 2	6
BH-24	110	11	100	10	54	160	< 2	26
BH-25	60	5	40	2	< 10	200	< 2	20
BH-26	270,000	13,000	35,000	2,200	2,800	1,500,000	160	60,000
BH-27	76,000	7,600	7,200	640	< 100	520,000	< 10	40,000
BH-28	14,000	700	4,400	290	50	79,000	6	3,400
BH-29	6,200	470	1,100	87	10	40,000	< 2	3,500
BH-30	13,000	1,000	4,100	190	100	60,000	6	5,000
BH-31	46,000	6,700	21,000	1,600	600	230,000	< 10	65,000
BH-32	43,000	3,400	18,000	1,200	200	300,000	60	18,000
BH-33	61,000	4,300	12,000	860	10	440,000	< 2	30,000
BH-34	45,000	3,400	26,000	1,500	100	270,000	< 10	24,000
BH-35	34,000	2,100	21,000	860	100	300,000	10	18,000
BH-36	39,000	2,600	15,000	980	200	240,000	50	13,000
BH-37	20,000	1,500	12,000	620	200	60,000	< 10	8,000

*See Appendix B for Dates of Samples

**Data Collected during Sampling Period No. 1 in May 1968 unquestionably was due to the limited chlorination capacity of the Deer Island and Nut Island facilities. Increased coliform densities during the last week in September may have been due to the discharge of settled sludge. Future sludge discharges will be limited to the first two hours of ebb tide. Further work during 1969 will determine the influence of this practice on coliform counts.

Figure 3 shows the approved water quality classifications and the areas which fail to meet these classifications. The Outer Harbor in the vicinity of Moon Island and Deer Island falls considerable short in meeting the bacterial standards set for it under the Massachusetts Coastal and Marine Water Standards of Quality.(3)

The data shows that the Deer Island waste water treatment facility is a major contributor to the degradation of the Outer Harbor and vicinity, whereas, the Nut Island and Moon Island facilities affect the waters surrounding their outfalls to a much lesser extent. It should be noted that both Deer Island and Nut Island have increased their chlorination capacity and are preparing for year round chlorination at substantially higher dosage rates. This is anticipated to markedly enhance the bacterial quality of the harbor waters.

Samples of chlorinated sewage treatment plant effluent from Nut Island averaged 3,400 total coliforms per 100 ml while the sludge pumped from the same plant averaged 360,000,000 total coliforms per 100 ml with a high count of 700,000,000 coliforms per 100 ml (see Table 10). Chlorinated effluent from the Deer Island waste water treatment facility averaged 35,000 total coliforms per 100 ml when the sample was allowed to be in contact with chlorine for 20 minutes in a laboratory test.

TABLE 10

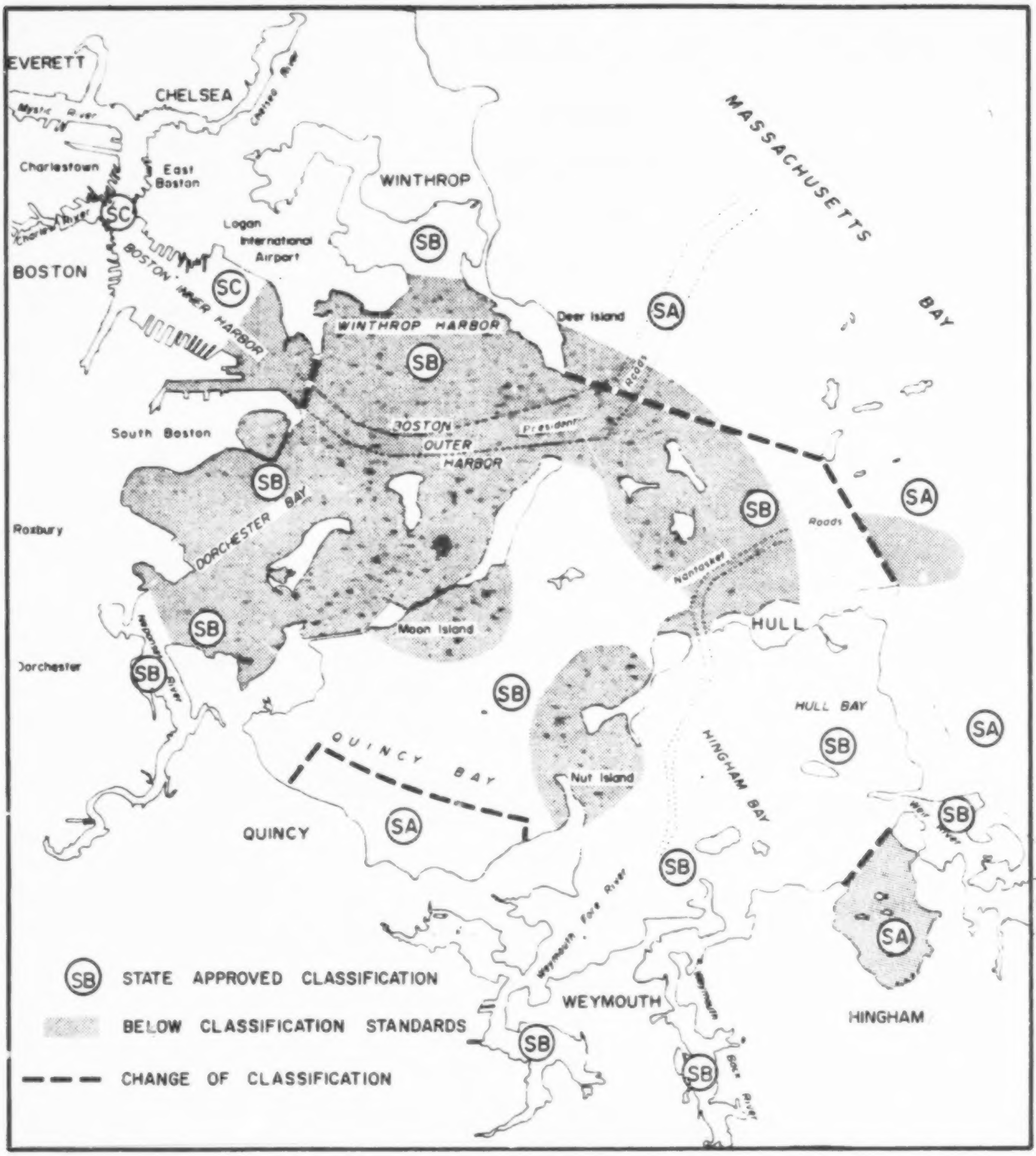
BOSTON HARBOR

SUMMER - 1968

SUMMARY - SPECIAL SAMPLES DATA

Coliform per 100 ml (MF)

STATION	SAMPLE		Coliforms per 100 ml	
			Total	Fecal
Nut Island S.T.P.	Chlorinated Effluent	Mean	3,400	130
		Median	4,600	130
		Minimum	300	20
		Maximum	5,600	300
	Sludge	Mean	360,000,000	11,000,000
		Median	365,000,000	9,500,000
		Minimum	22,000,000	6,700,000
		Maximum	700,000,000	17,000,000
Squantum Pumping Station	Raw Sewage (only one sample)	Mean	59,000,000	4,400,000
		Median	-	-
		Minimum	-	-
		Maximum	-	-
Deer Island S.T.P.	Chlorinated Effluent (excluding sludge)	Mean	35,000	490
		Median	17,000	310
		Minimum	7,300	140
		Maximum	100,000	1,200


EVERETT
CHELSEA
Mystic River
Chelsea River
Charlestown
East Boston
SC
Charles River
BOSTON
BOSTON INNER HARBOR
Logan International Airport
SC
WINTHROP
SB
MASSACHUSETTS BAY
WINTHROP HARBOR
SB
Deer Island
SA
Roads
South Boston
BOSTON OUTER HARBOR
President
SB
Roxbury
DORCHESTER BAY
SA
SB
Roads
Nantasket
Moon Island
SB
HULL
Dorchester
SB
Neponset River
SB
HULL BAY
SA
SB
QUINCY BAY
Nut Island
HINGHAM BAY
QUINCY
SA
SB
Weir River
SB
Weymouth Fore River
SA
WEYMOUTH
HINGHAM
SB
SB
Back River
SB STATE APPROVED CLASSIFICATION
BELOW CLASSIFICATION STANDARDS
CHANGE OF CLASSIFICATION

BOSTON HARBOR
COLIFORM CLASSIFICATION STANDARDS

SUMMER-1968

FIGURE 3

These figures are below what will be expected when sludge is discharged into the effluent line. Sludge not only utilizes all the chlorine available, but also adds significant coliforms which are not killed by the chlorine.

Although the Boston Inner Harbor was not sampled for bacteriological content during 1968, the data accumulated during the 1967 study shows that this is another primary source of bacterial pollution to the Outer Harbor.

Figure 4 illustrates the present water quality of the study area according to the coliform limits set forth in the official Massachusetts Classification Standard. It must be noted that while the median coliform values at some locations indicate the proposed standard is being met, in some cases more than 10 percent of the individual samples did not meet the requirements of the standards. Classes SA and SB define the coliform limits by actual numbers while in Class SC, they are limited only to non-interference with the legitimate water uses assigned to this class.

Bacterial data collected in Boston Harbor and adjacent bays indicates that to meet the Water Quality Standards for coliforms, it will be necessary to provide more effective disinfection of wastes, including sludge, entering the harbor or by some discharge outside the harbor area.

DISSOLVED OXYGEN

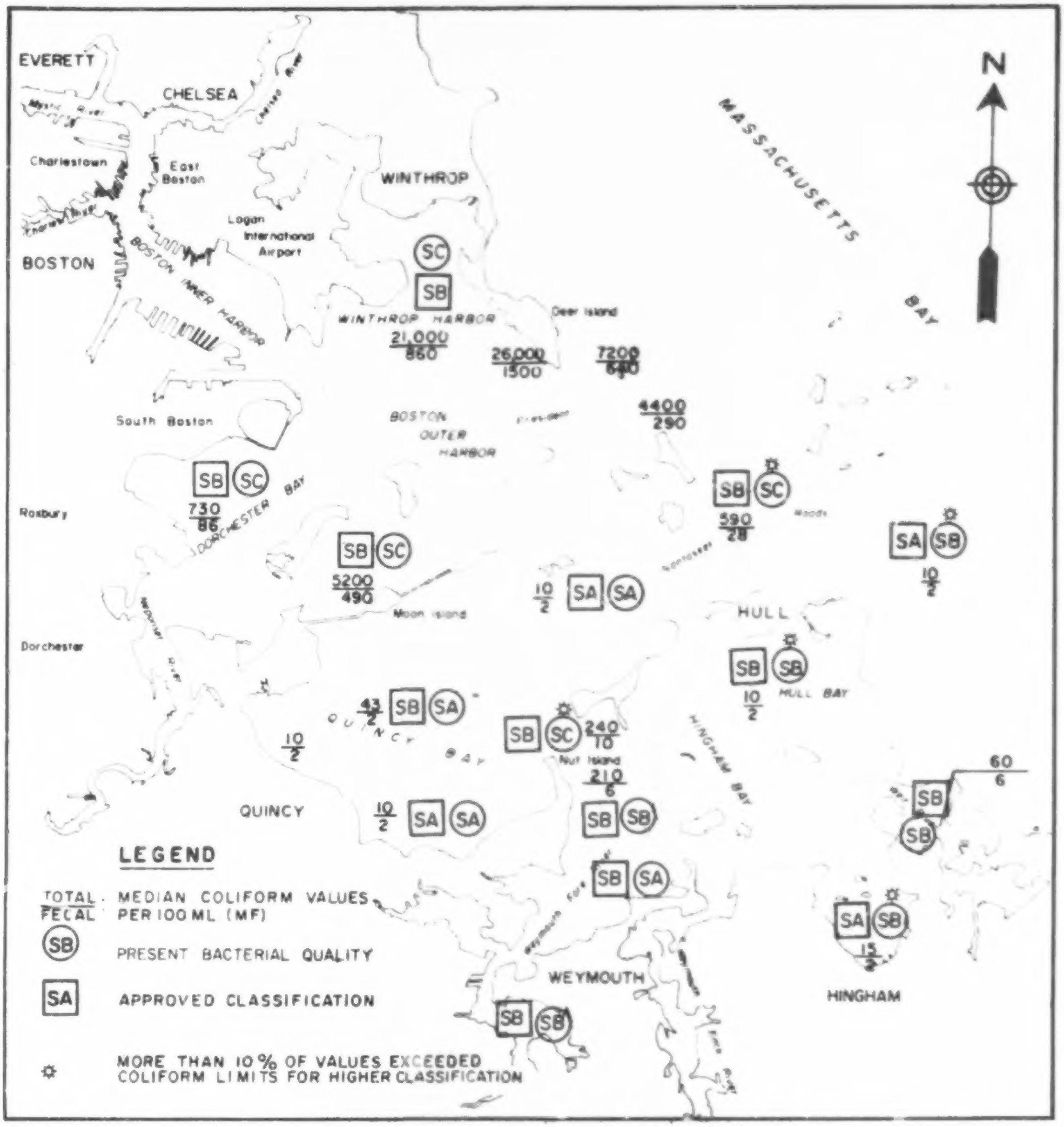
The oxygen demand of sewage and industrial wastes, as measured by the biochemical oxygen demand test (BOD), indicates the waste's potential for reducing the dissolved oxygen content of the receiving water. Adequate dissolved oxygen levels are necessary to support fish and other aquatic life. If dissolved oxygen becomes totally depleted, hydrogen sulfide gas is produced creating obnoxious odors and unpleasant environment for persons living or working nearby. The hydrogen sulfide given off may turn nearby houses, bridges or other painted structures black.

The azide modification, as found in Standard Methods(1), was used to determine the dissolved oxygen content of the water during the 1968 survey. In 1967, the dissolved oxygen probe was used to determine the dissolved oxygen.

Compliance with Standard

Water Quality Standards, adopted by Massachusetts, require that the dissolved oxygen for Class SA water be "....not less than 6.5 mg/l at any time..."; for Class SB water, be "...not less than 5 mg/l at any time..."; and for Class SC water, the lowest classification of salt water, "...not less than 5 mg/l during at least 16 hours of any 24-hour period, nor less than 3 mg/l at any time...." Four of 41 stations or 6 of 528 samples tested during 1968 had dissolved oxygen levels below the standards set by the Commonwealth of Massachusetts Classification of Boston Harbor (see Figure 5). Of the 41 stations sampled, only one station failed to meet dissolved oxygen standard of the "SC" classification. This compares with twelve of eighteen stations which failed to meet the "SC" classification during the 1967 study.

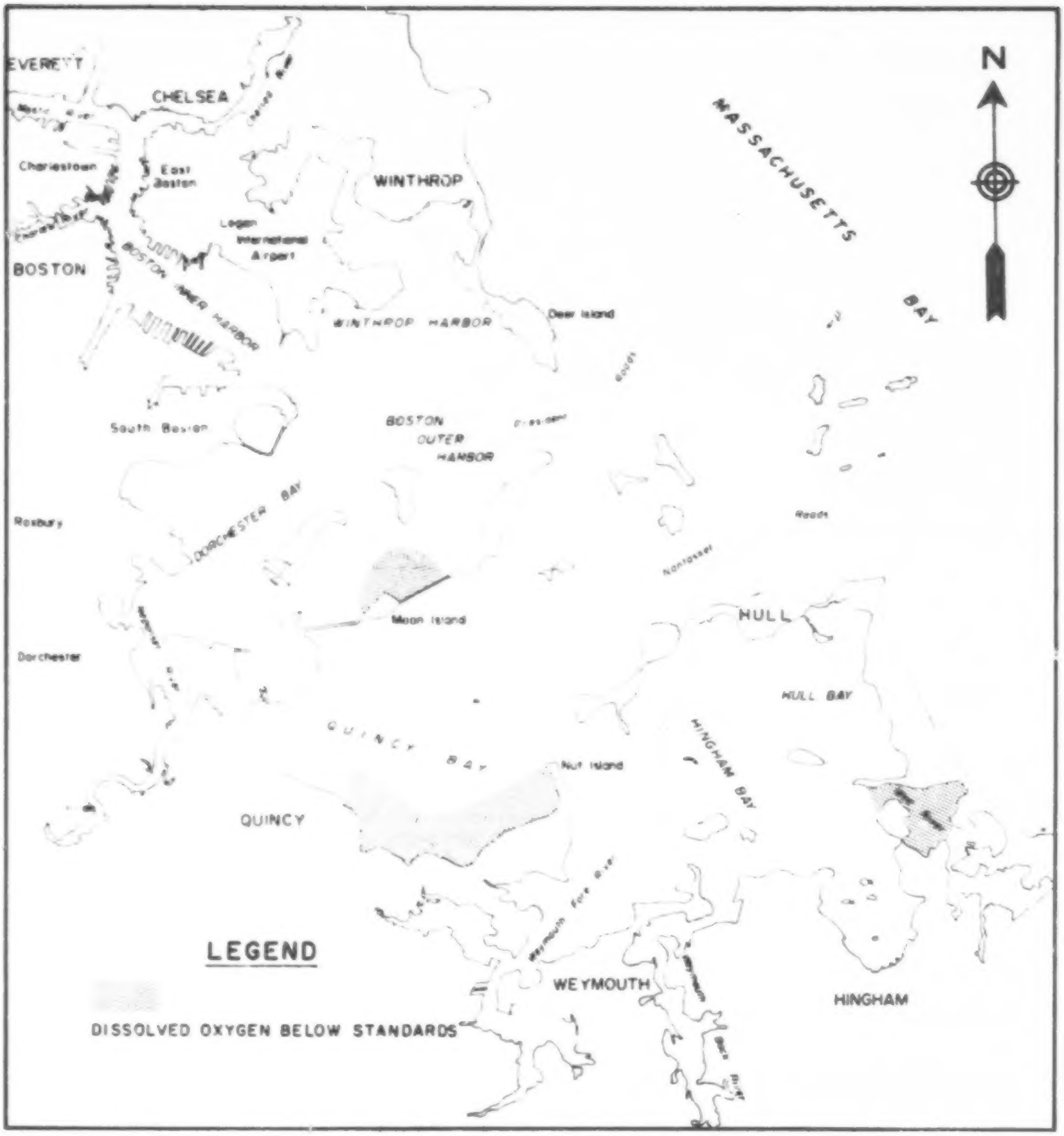
Station BH-2, located at the mouth of the Weir River, had a dissolved oxygen level below 3.0 mg/l in two of three samples collected. Raw


EVERETT
CHELSEA
Mystic River
Chelsea River
Charlestown
East Boston
Charles River
BOSTON
Logan International Airport
BOSTON INNER HARBOR
WINTHROP
N
MASSACHUSETTS BAY
SC
SB
WINTHROP HARBOR
Deer Island
21,000
860
26,000
1500
7200
640
4400
290
South Boston
BOSTON OUTER HARBOR
SB
SC
730
86
DORCHESTER BAY
Roxbury
SB
SC
590
28
SA
SB
10
2
SB
SC
5200
490
Moon Island
10
2
SA
SA
HULL
Dorchester
SB
SB
10
2
HULL BAY
43
2
SB
SA
QUINCY BAY
10
2
SB
SC
240
10
Nut Island
210
6
HINGHAM BAY
60
6
SB
SB
QUINCY
10
2
SA
SA
SB
SB
SB
SA
SA
SB
15
2
WEYMOUTH
HINGHAM
SB
SB
LEGEND
TOTAL
FECAL
MEDIAN COLIFORM VALUES PER 100 ML (MF)
SB
PRESENT BACTERIAL QUALITY
SA
APPROVED CLASSIFICATION
☼
MORE THAN 10 % OF VALUES EXCEEDED COLIFORM LIMITS FOR HIGHER CLASSIFICATION

BOSTON HARBOR
COLIFORM VALUES

SUMMER- 1968

FIGURE 4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CHELSEA
Charlestown
East Boston
WINTHROP
MASSACHUSETTS BAY
Logan International Airport
BOSTON
BOSTON INNER HARBOR
WINTHROP HARBOR
Deer Island
South Boston
BOSTON OUTER HARBOR
DORCHESTER BAY
Roxbury
Roads
Nantasket
Moon Island
HULL
Dorchester
HULL BAY
QUINCY BAY
Nut Island
HINGHAM BAY
QUINCY
LEGEND
DISSOLVED OXYGEN BELOW STANDARDS
Weymouth Fore River
WEYMOUTH
Back River
HINGHAM

BOSTON HARBOR

LOCATION OF AREAS WITH DISSOLVED OXYGEN LEVELS BELOW THOSE SET BY STANDARDS

FIGURE 5

sewage, which has a high BOD and can reduce the oxygen level, is discharged into the Weir River by the town of Hull.

One of 69 samples collected at Station BC had less than 5.0 mg/l oxygen. Station BC is located off Moon Island near the discharge point for the Moon Island sewage holding facility. The other Stations, BH-15 and BH-16, are located in the southeast section of Quincy Bay. Station BH-15 showed less than 6.5 mg/l dissolved oxygen in one of eight samples. Station BH-16 had less than 6.5 mg/l oxygen in two of eight samples.

Oxygen consuming biological activities require several hours to produce a significant decrease in the oxygen level. The low dissolved oxygen of the southeast section of Quincy Bay indicates the biological action has sufficient time to reduce the oxygen level. Thus, the water in these areas is probably partially retained rather than flushed with the tide.

Fluctuation in Levels

A small fluctuation in the dissolved oxygen level was observed (Figures 6 to 9). Fluctuation in the dissolved oxygen levels may have been caused by the production of oxygen through photosynthesis and movement of water during the tidal cycle. Most of the oxygen production through photosynthesis is limited to the daylight hours; at night, photosynthesis is significantly decreased while respiration continues creating an oxygen demand on the water.

The dissolved oxygen at most stations increases during the flood tide and decreases during the ebb tide; cleaner water from Massachusetts Bay raises dissolved oxygen levels as it enters the harbor, while the dissolved oxygen in the Outer Harbor is reduced during the ebb tide by the poorer quality of water from the Inner Harbor.

Variations in the dissolved oxygen level during 1968 were smaller than variations observed in 1967 at the comparable station (see Figure 10). The large variation in the 1967 dissolved oxygen levels was attributed, in part, to phytoplankton activity.

Dissolved oxygen levels in Boston Harbor dropped after a major rainstorm. The U. S. Weather Bureau Station at Logan Airport reported 0.74 inches of rain between 1:00 pm and 4:00 pm on August 7, 1968. Figures 6 through 9 show that the dissolved oxygen observations on the morning of August 8 were generally lower than the two previous mornings. Station BB shows an immediate drop in the dissolved oxygen level while the other station showed more of a gradual decrease. The immediate drop at Station BB is probably the result of a chemical oxygen demand exerted by the combined sewer and storm water overflows.

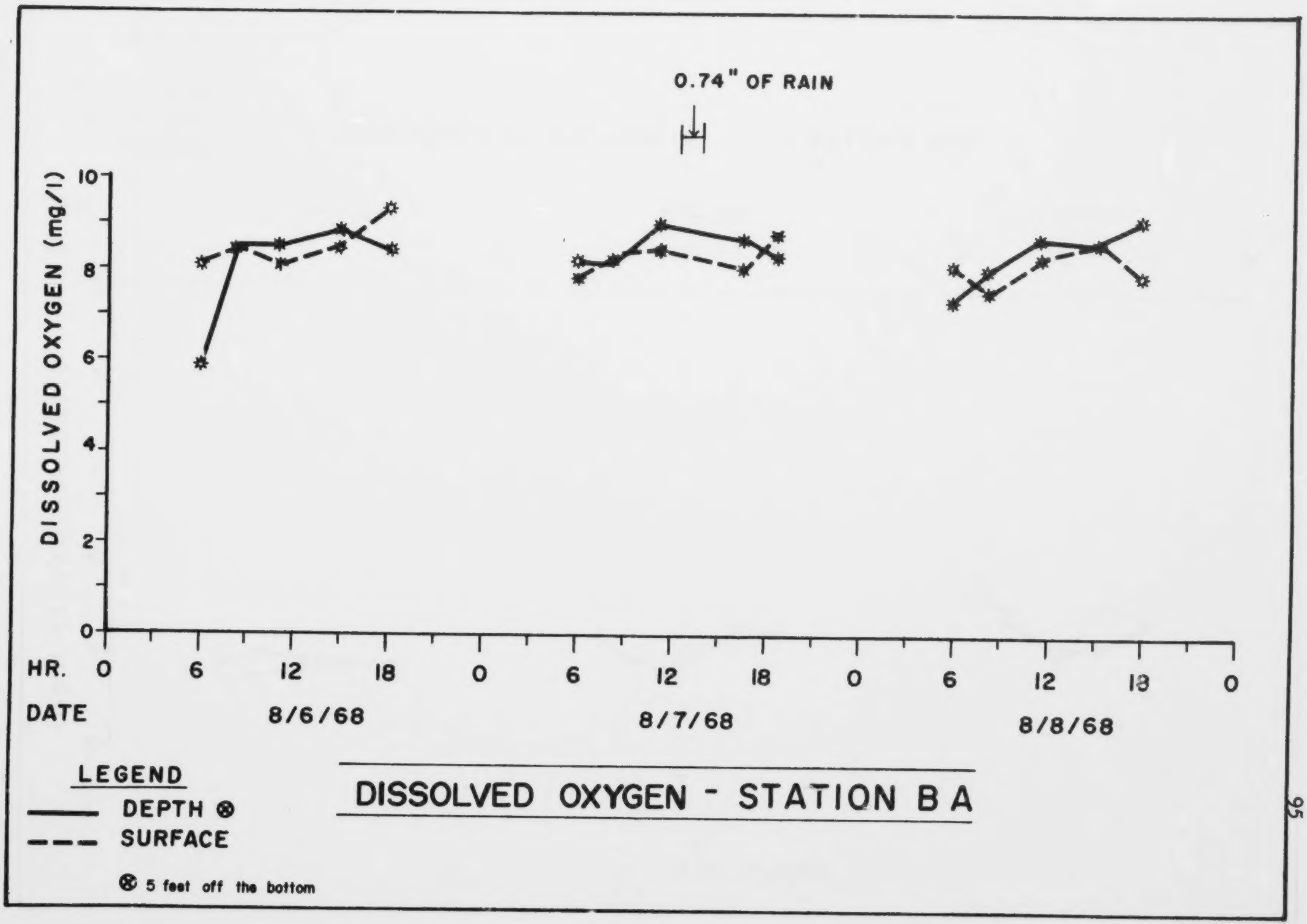
The dissolved oxygen level in Boston Harbor is affected by: raw and partially treated sewage discharges, the discharge of sludge material, the BOD of the harbor tributaries, photosynthetic activities, the mixing with the cleaner water of Massachusetts Bay, storm water overflow and other minor factors. Acceptable limits of dissolved oxygen levels were found in all but three areas (Figure 5) in Boston Harbor during 1968.

Figure 11 shows the minimum DO levels obtained in Boston Harbor during 1968.

BIOLOGICAL CONDITIONS

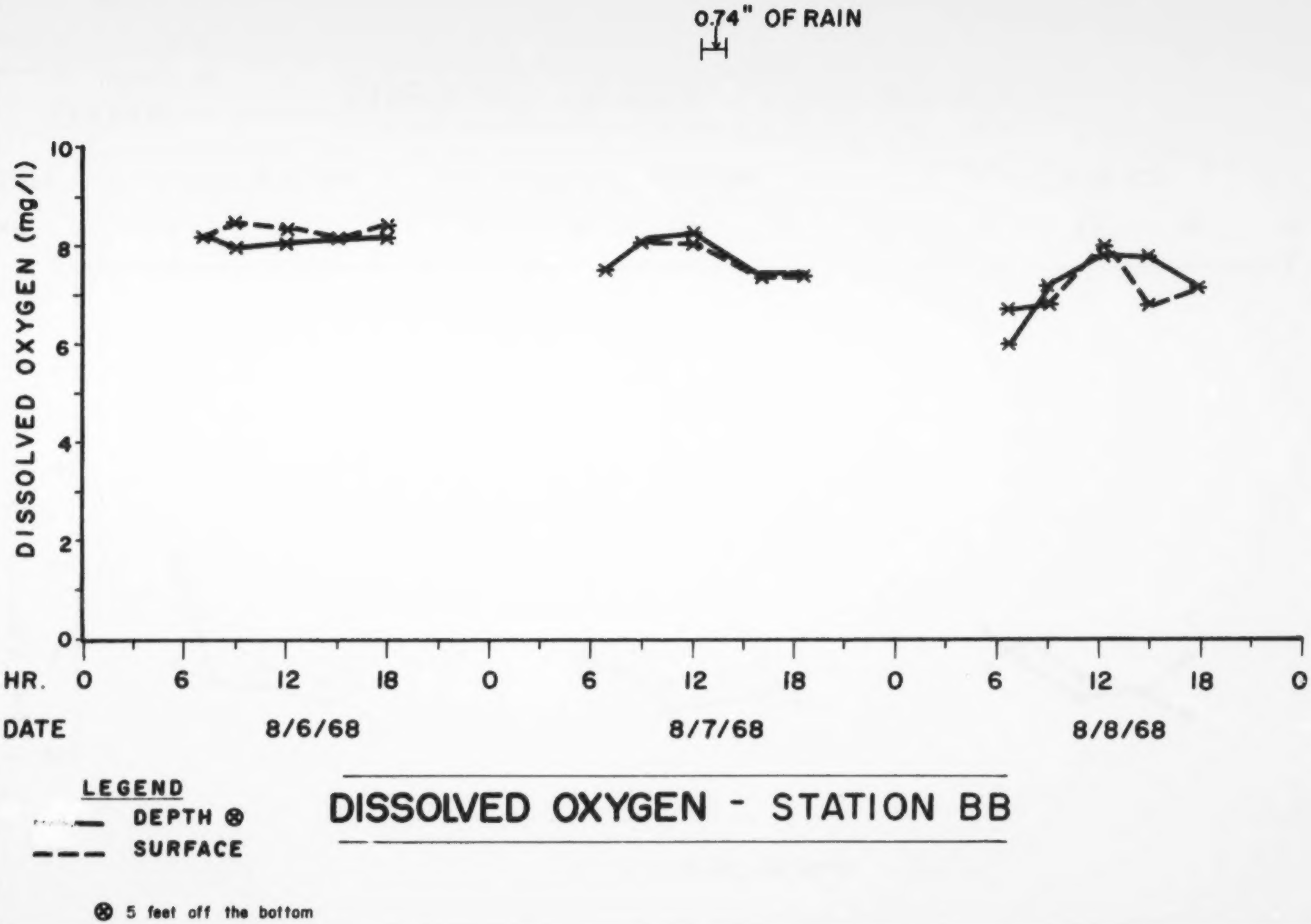
Benthic

A biological survey was conducted to determine the harbor condition as indicated by its benthic (bottom dwelling) populations, and to compare



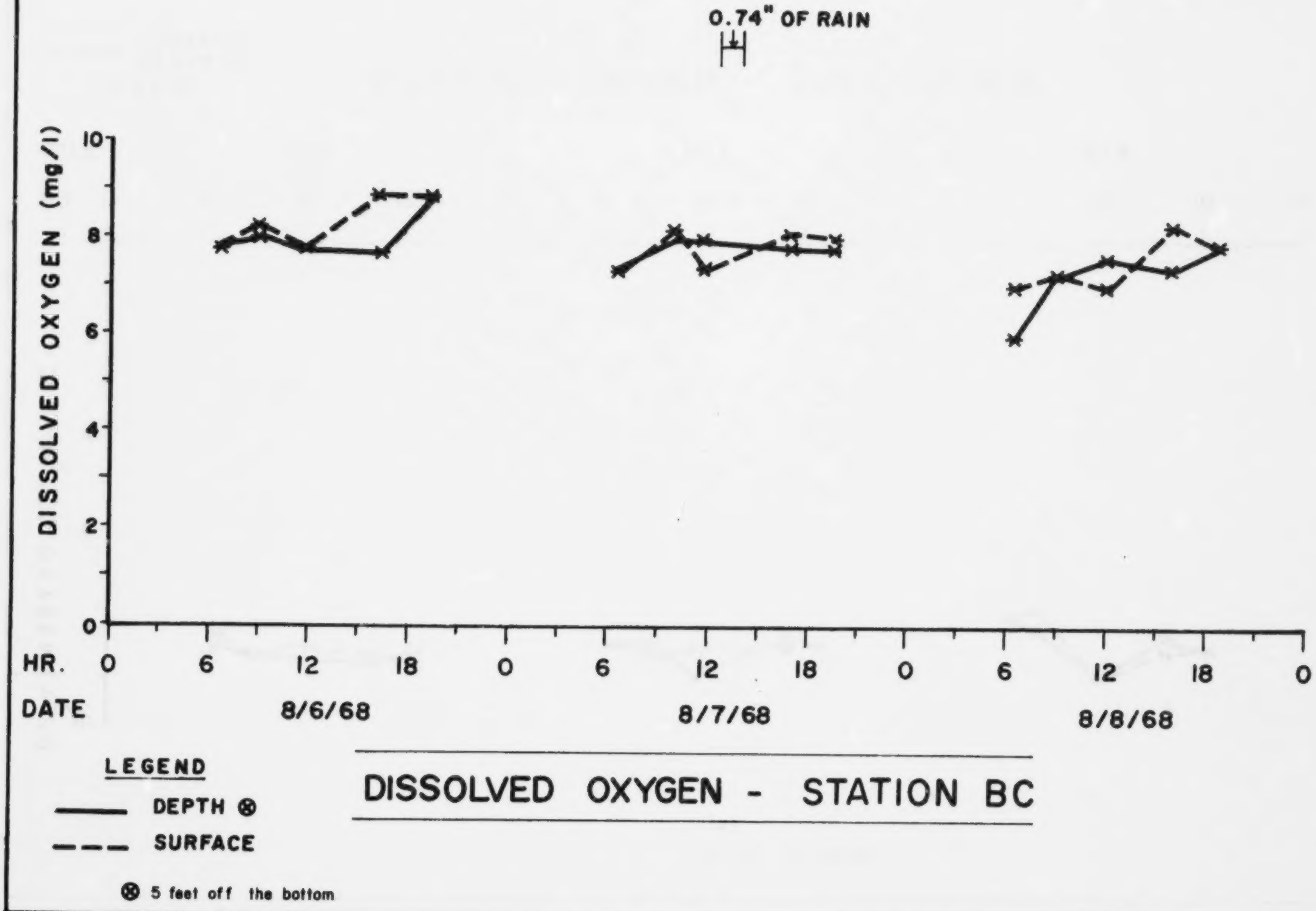
DISSOLVED OXYGEN - STATION B A

FIGURE 6



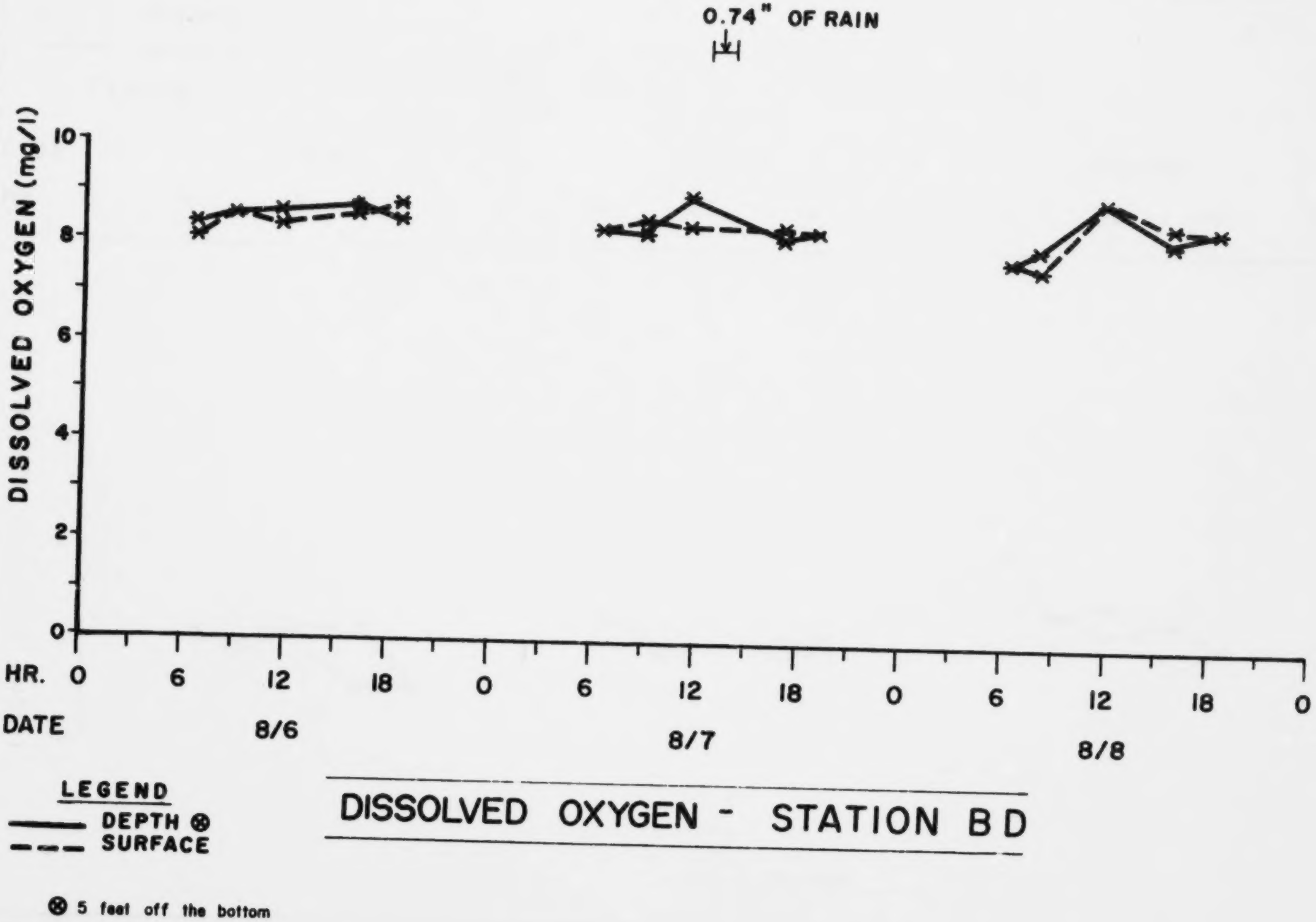
DISSOLVED OXYGEN - STATION BB

FIGURE 7



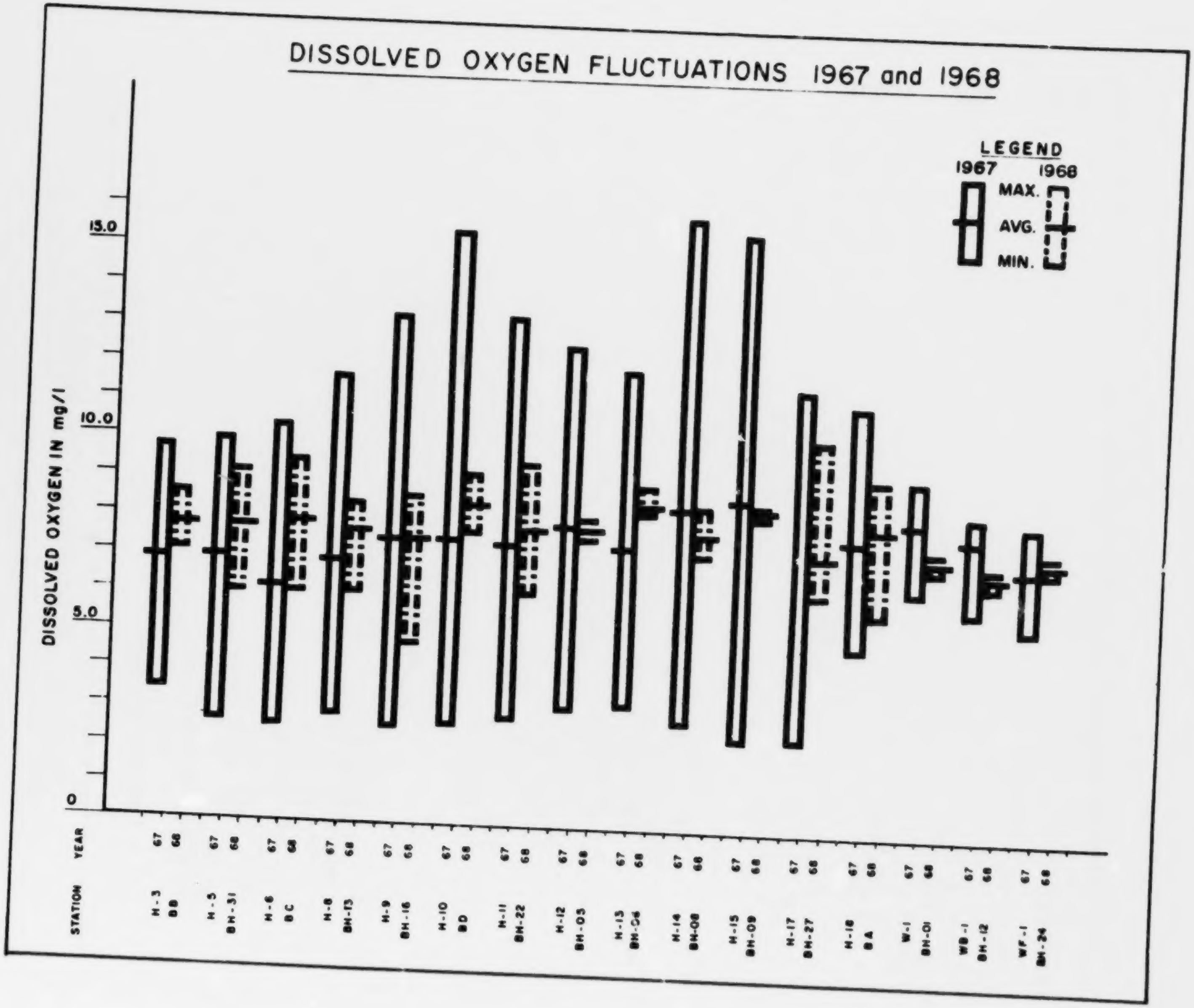
DISSOLVED OXYGEN - STATION BC

FIGURE 8



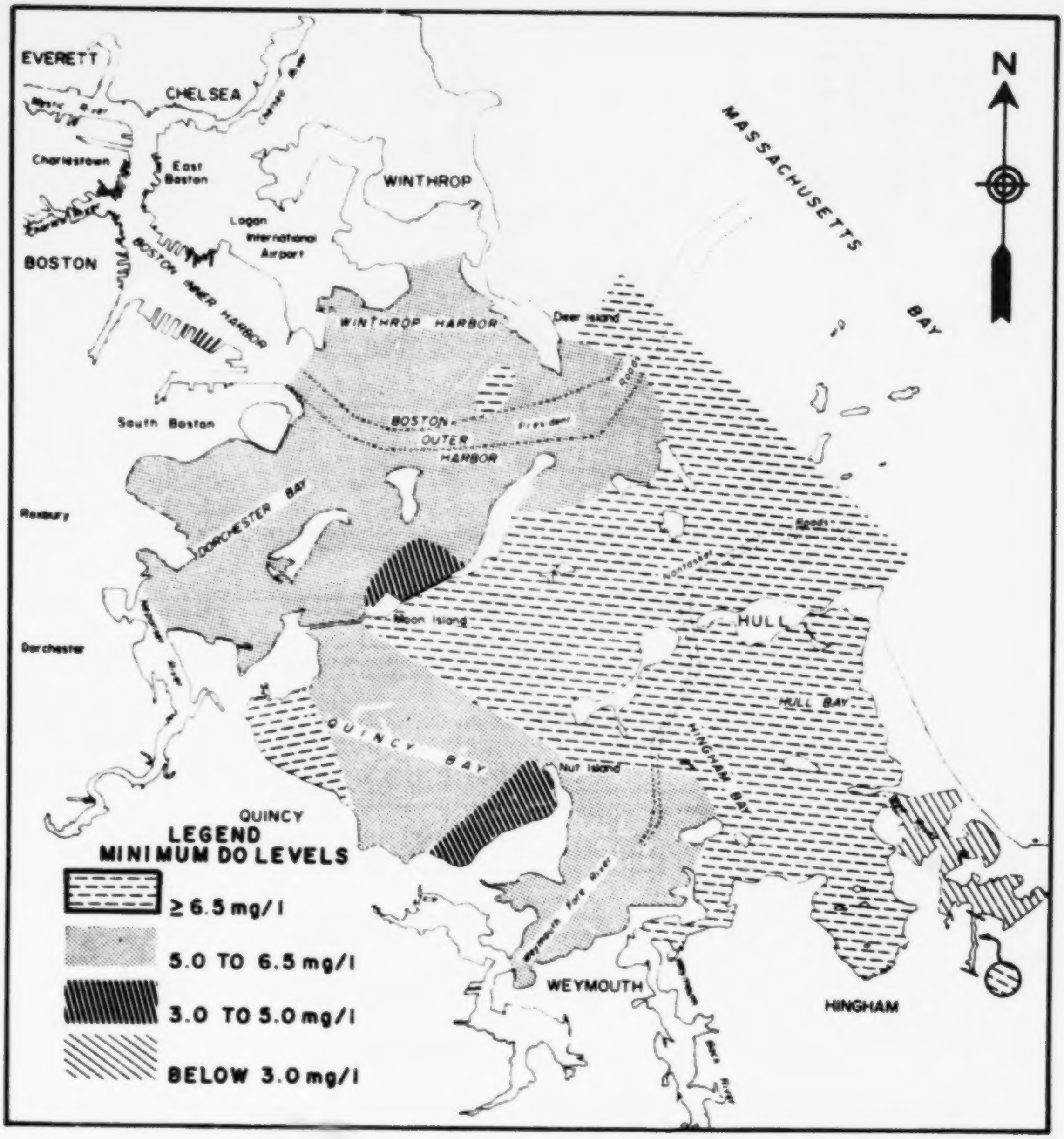
DISSOLVED OXYGEN - STATION BD

FIGURE 9



DISSOLVED OXYGEN FLUCTUATIONS 1967 and 1968

FIGURE 10


EVERETT
CHELSEA
Mystic River
Chelsea River
Charlestown
East Boston
WINTHROP
Logan International Airport
BOSTON
BOSTON INNER HARBOR
N
MASSACHUSETTS BAY
WINTHROP HARBOR
Deer Island
South Boston
BOSTON OUTER HARBOR
President Roads
DORCHESTER BAY
Roxbury
Nantasket Roads
Moon Island
HULL
Dorchester
HULL BAY
QUINCY BAY
Nut Island
HINGHAM BAY
QUINCY
WEYMOUTH
HINGHAM
LEGEND
MINIMUM DO LEVELS
≥ 6.5 mg/l
5.0 TO 6.5 mg/l
3.0 TO 5.0 mg/l
BELOW 3.0 mg/l

BOSTON HARBOR
DISSOLVED OXYGEN

SUMMER 1968

FIGURE 11

the harbor's present state with results of a similar survey conducted during July 1967.(8)

Sampling techniques and station selection of the 1967 biological survey were duplicated during this survey in order to attempt to offer some basis for comparison of past and present conditions. The 1967 stations are shown in Figure 12 and are listed in Appendix A.

The relatively high salt water influx to the harbor described earlier, facilitates vertical mixing and promotes the growth of strict marine organisms rather than estuarine types.

Inner Harbor

The Inner Harbor is directly affected by the influx of three polluted tributaries: the Charles, Mystic and Chelsea Rivers. In addition, most of the major docking facilities in Boston Harbor are located in this area. Commercial and naval facilities line both sides of the Inner Harbor; oil spillage and waste disposal from ships contribute to the grossly polluted condition of this area. Bottom sediments consisted mainly of a black, oily deposit that emitted strong hydrogen sulfide (H_2S) odors indicating organic decomposition.

Gastropod and polychaete worms were the only types of benthic life present with polychaete densities of 330 per square foot (Appendix - Table C). The major polychaete type was Polydora ligni, a sedentary worm whose food source is organic deposits. Sediments of the Inner Harbor provided an almost inexhaustable food supply for this worm, while adverse substrate changes eliminated most of its predators and competitors. Results of the 1967 survey indicated polychaete densities of 964 per square foot.

Annual changes in larval distribution, in addition to recent dredging operations (see Figure 13) before the 1968 survey, were probably the major reason for this apparent decrease in polychaete numbers.

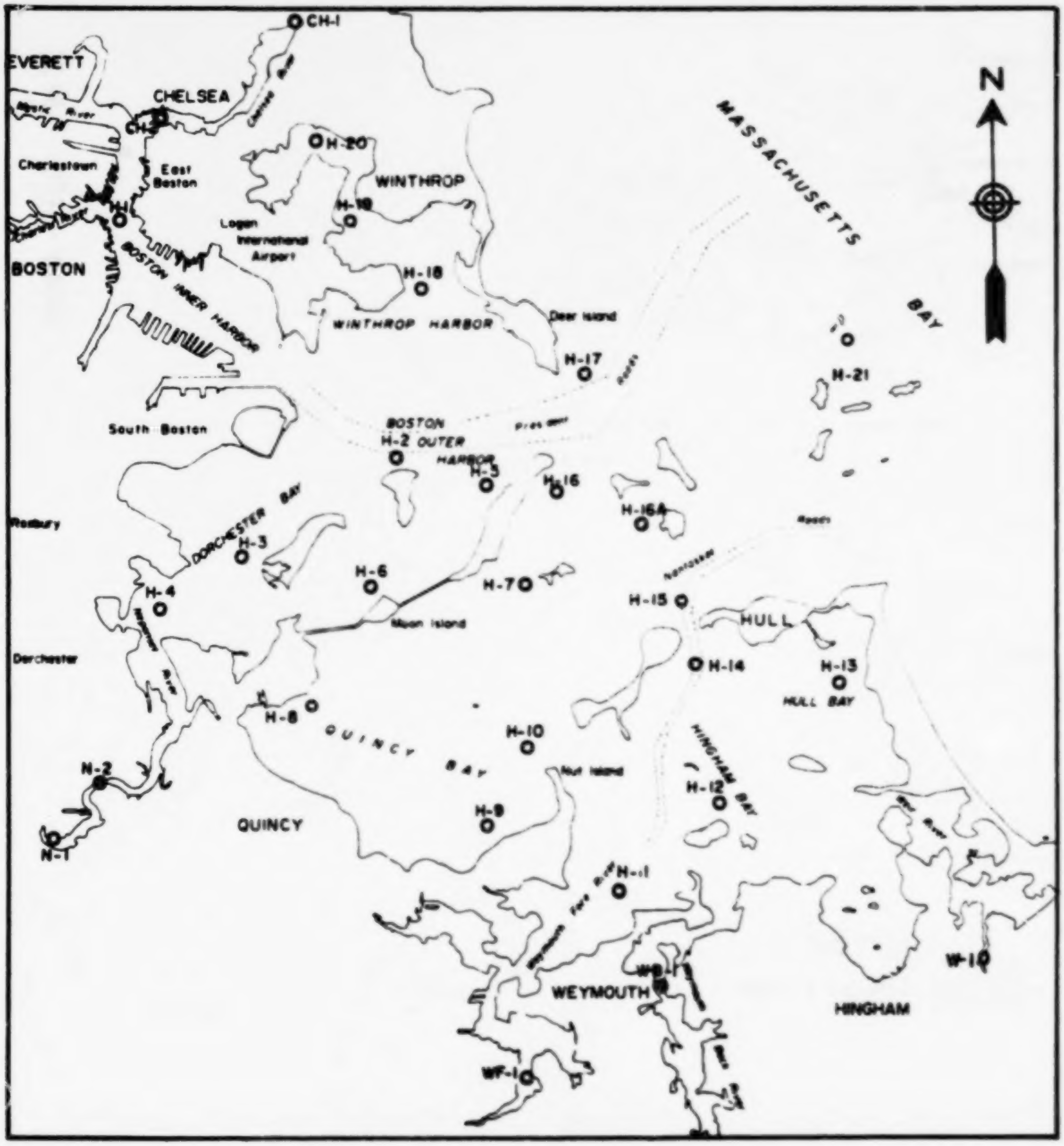
The Inner Harbor is polluted and provides an unsuitable environment for most types of benthic marine life.

Winthrop Bay

Certain combined sewer outfalls drain into Winthrop Bay and result in polluted conditions there. The sewage and sludge discharged during flood tide contain solids that could settle in the bay.

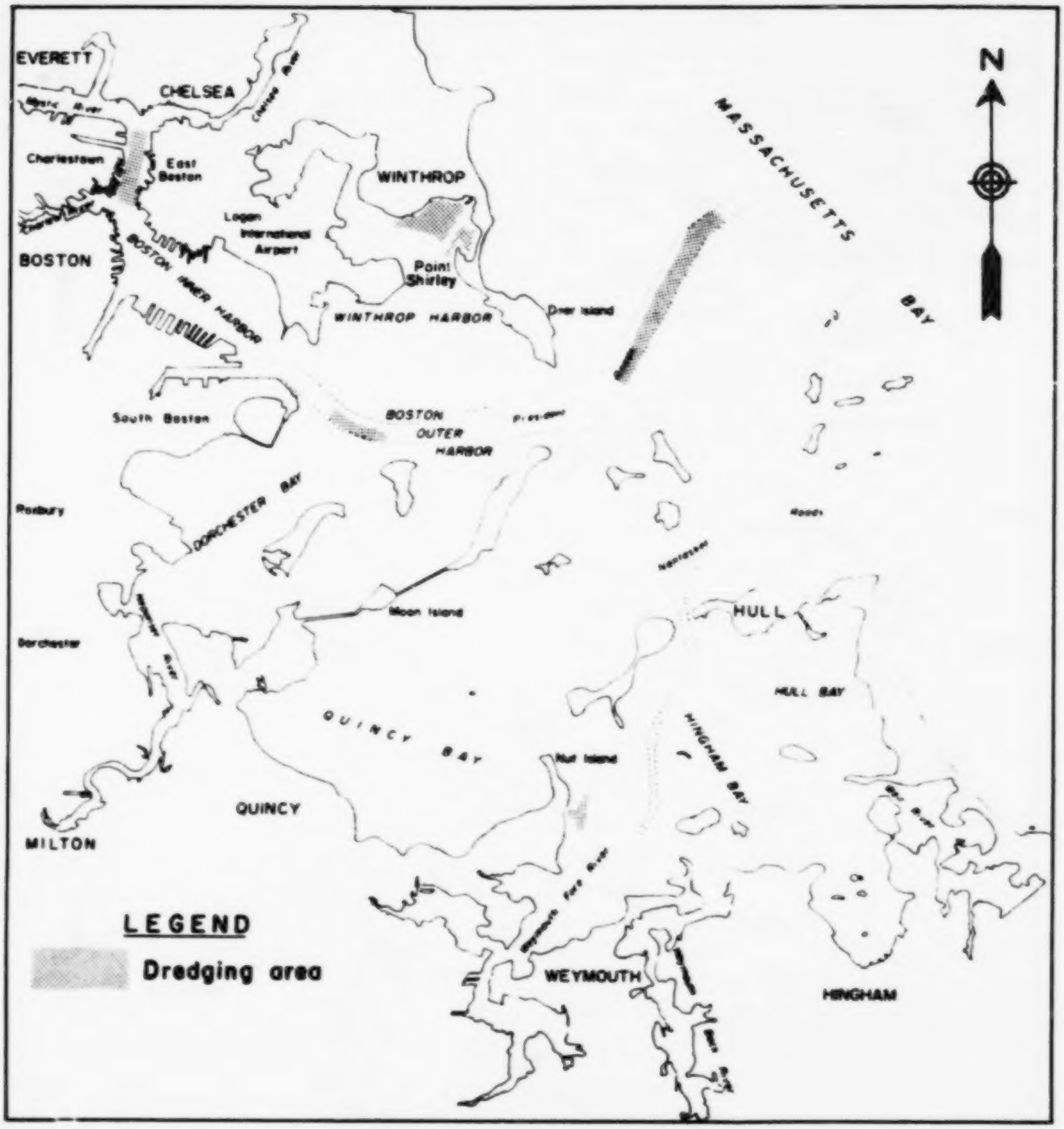
Sediments at BH-44, the most inland reach of this area, consisted of black, oozy material which had a strong H_2S odor. Gas bubbled to the surface during sampling, indicating anerobic benthal decomposition. Three types of benthic organisms were found, predominated by the polychaete worm *Capitella capitata*. This marine worm has been cited (18) as being analogous to the fresh water tubificid worm, which is a pollution tolerant form able to thrive in highly enriched environments. *Capitella* is a burrower that feeds entirely on organic sediments. Sedimentation of organics, which eliminates most life forms, is actually beneficial to this organism. The other significant type present at this station was the burrowing amphipod *Corophium volutator*, which, like *Capitella*, feeds on organic debris.

Station BH-43 (see Figure 1) is located in a narrow channel of Winthrop Bay bordered by Logan Airport and Winthrop. Strong tidal currents through this channel prevent excessive deposition of suspended materials. Sediments in this reach consisted mostly of coarse sand


CH-1
EVERETT
CHELSEA
Mystic River
CH-2
Charlestown
East Boston
H-20
WINTHROP
H-1
H-19
Logan International Airport
BOSTON
BOSTON INNER HARBOR
H-18
WINTHROP HARBOR
Deer Island
MASSACHUSETTS
BAY
N
H-17
H-21
South Boston
BOSTON
H-2 OUTER
HARBOR
H-5
H-16
H-16A
Roxbury
DORCHESTER BAY
H-3
H-6
H-7
H-4
H-15
Nantasket
Roads
HULL
Moon Island
Dorchester
H-14
H-13
HULL BAY
H-8
QUINCY BAY
H-10
Nut Island
HINGHAM BAY
H-12
N-2
H-9
QUINCY
N-1
H-11
WEYMOUTH
WB-1
HINGHAM
W-1
WF-1

1967 STATION LOCATIONS IN BOSTON HARBOR

FIGURE 12


EVERETT
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Logan International Airport
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BOSTON INNER HARBOR
Point Shirley
WINTHROP HARBOR
Deer Island
MASSACHUSETTS BAY
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South Boston
BOSTON OUTER HARBOR
Roxbury
DORCHESTER BAY
Moon Island
HULL
Dorchester
HULL BAY
QUINCY BAY
Nut Island
HINGHAM BAY
QUINCY
MILTON
WEYMOUTH
HINGHAM
LEGEND
▨ Dredging area

BOSTON HARBOR

DREDGING BY CORPS OF ENGINEERS — U. S. ARMY and COMMONWEALTH OF MASSACHUSETTS
SEPTEMBER 1967 -
AUGUST 1968

FIGURE 13

with some organic ooze. Four types of organisms were present, including amphipods, mollusk, polychaetes and gastropods. Among these, the organic feeders previously mentioned predominated.

Station BA, at the mouth of Winthrop Bay, was inhabited by polychaete worms numbering 2,200 per square foot. Deposits of oily organic sediments found here indicate that wastes from the Deer Island waste water treatment facility consistently reach this area during the flood tide. Polydora ligni, the organic detritus feeder found in the Inner Harbor, comprised almost all of the polychaetes in this grossly polluted environment.

The distribution of organisms found in Winthrop Bay corresponds very closely to conditions found in the 1967 survey, although discrepancies in population densities may be noted due to dredging operations in the proximity of the station between the times of the two surveys (see Figure 13 and Appendix C). When these operations occur, densities of benthic populations are drastically decreased.

Dorchester Bay

The three stations in Dorchester Bay, BB, BC, and BH-40, all exhibited sediments composed entirely of black, organic ooze. Known pollution sources to this area are: combined sewer outfalls, the influx of the polluted Neponset River, polluted water from the Inner and Outer Harbors, and waste discharges from the Moon Island sewage holding facility.

Station BB was dominated by many species of polychaete worms. Polydora ligni and Tharyx acutus, both burrowing worms that feed on organic wastes, comprised the majority of this population. Other organisms included scuds, mollusks and gastropods.

This small variety of organism is typical of benthic conditions caused by degradation of water quality due to excessive enrichment.

Station BH-40 in Dorchester Bay exhibited a very low population (65 per square foot) of benthic invertebrates. The bottom sediment consisted of a black ooze that had a strong odor of H_2S. The paucity of life and advanced state of decomposition of the bottom sediment indicates that this environment is unsuitable for most benthic organisms. Findings of the 1967 survey showed polychaete worms numbering 1,200 per square foot, as compared to 30 polychaetes per square foot found during the 1968 survey. A degradation of water quality has evolved at Station BH-40 in Dorchester Bay.

Station BC, also in Dorchester Bay, was typical of general conditions in this part of Boston Harbor. Bottom sediments were comprised entirely of black ooze, which had a septic odor, and life forms found here were not typical of good water quality. Polychaetes and amphipods comprised the major groups of life present. As in other areas of Boston Harbor, burrowing forms that utilize organic deposits as a food source were the major species of these groups. Polydora ligni was the dominant polychaete at this station.

Quincy Bay

Sediments in Quincy Bay varied from area to area, and the deposition of organic material appeared to depend on the tidal currents. Station BH-13 exhibited sediments consisting of gravel and sand, with a small percentage of organic material. Suspended organic material most likely does not consistently reach this area, thus, deposition of solids is limited. Ten species of organisms were present, dominated by Polydora ligni and Ampelisca macrocephala which thrive on organic sediments. However, the density of these organisms was limited by the minimal amount of organic deposition, and unstability of the sediment, which are constantly turned over by changing tidal currents.

Station BH-16, on the southeastern side of Quincy Bay, exhibited large amounts of organic deposition. The strong H_2S odors of the sediments suggest active decomposition, and benthic life was limited to 45 organisms per square foot. Poor tidal flush rates in this part of the Bay allow extended accumulation of suspended organic materials. Because of this, the products of decomposition of the organic sediments may reach a concentration that is toxic to most life forms, thus reducing the population level to the small number found here.

Hingham-Hull Bay

Samples collected from Hingham Bay indicated that a polluted condition existed throughout this area. Stations BH-22, BH-46, and BH-06 all consisted of sediments with large amounts of organic deposits, and all exhibited the characteristic odor of decomposition. Population densities at these stations ranged from 3,500 organisms per square foot at Station BH-46 to 3,000 organisms per square foot at Station BH-06.

The major organism at these stations was Ampelisca macrocephala. In all three cases, the density of this amphipod exceeded 1,300 per square foot. Other organisms of note in this bay are Polydora ligni and Tharyx acutus, the organic-feeding polychaetes prevalent throughout the polluted areas of Boston Harbor.

Strong tidal currents at Station BH-08 near Hull Gut prevented excessive accumulation of organic material on the bottom, with the result that less than 520 organic-feeding organisms per square foot were found. The amount of organic deposition available as a food source to these organisms is a limiting factor to the potential population density at any one location.

Outer Harbor

Boston Outer Harbor was sampled at the following stations: BD, BH-09, BH-19, BH-31, BH-39, BH-41 and BH-42 (Figure 1). Four sewerage facilities; Deer Island, Long Island, Moon Island and Nut Island; discharge waste into this area.

At Station BH-39, north of Spectacle Island, the bottom material consisted of 75 percent rock, sand and gravel, and 25 percent organic matter. The dominant organism at this station was the free-swimming polychaete Phyllodoce groenlandica which is normally associated with sand and shells. This station has a total benthic population of 180 per square foot. The 1967 survey reported severely enriched conditions at this station with the bottom deposits containing more than 5,000 polychaete worms per square foot. Station BH-39 is in the main shipping channel and was dredged between the 1967 and 1968 surveys (see Figure 13), thus changing the composition of the bottom from a highly enriched sediment to one consisting mainly of rock, sand and gravel. Consequently a corresponding change took place in the benthic fauna from one of a dense population of over 5,000 polychaetes per square foot to the comparatively sparse population of less than 200 per square foot.

Station BH-37 had bottom sediments of dark colored oozy mud with a septic odor. This station receives pollutants mainly from outfalls at the north end of Long Island which includes the sludge from Nut Island waste water treatment facility. The dominant organism at this station was Polydora ligni with a population of 750 per square foot. This polychaete is a characteristic organism of grossly polluted environments. A predacious feeding amphipod Caprella linearis was the second dominant species at this station and was present in numbers of 90 per square foot.

The black, greasy mud deposits at Station BH-19 contained a dense population of 4,000 benthic organisms per square foot. Amphipods numbering over 2,800 prevailed, Ampelisca macrocephala being dominant with 1,300 per square foot. High population of benthic invertebrates such as these are known to thrive in bottom sediments that are excessively rich in organic matter.

Strong tidal currents flowing through West Gut between Quincy Bay and Hingham Bay prevent any great deposition of organic matter on the bottom at Station BD. Several dredge samples at this station contained mostly rock, sand, and a lesser amount of oozy material. A septic odor was not detected. The bottom sample that was analyzed contained only 150 organisms per square foot. The burrowing fringed worm Cirratulus grandis was the dominant organism at this station in conjunction with several species of polychaetes and amphipods. A few clams and starfish were also present. A polluted condition is suggested at this station because of the dominance of the burrowing forms of polychaetes and the lack of organisms that are associated with clean water such as chitons, brittle-stars, sea urchins, and the free swimming polychaetes and amphipods found in clean water.

Polychaetes, amphipods, bivalves, sowbugs, snails and a brittle-star were found in the bottom sample of the moderately polluted water at Station BH-47. An extremely strong tidal current flows through Hull Gut, at Station BH-47, between Peddocks Island and Pemberton Point. Only a small number of the sedentary polychaetes *Aricidea jeffreysii*, 31 per square foot, were found in sediment composed of mostly small stone, sand, and a dark colored mud.

Strong odors of decomposition emanated from black, greasy bottom sediments of Stations BH-41 and BH-42. Foul-smelling bottom sediments of this polluted water contained mostly burrowing polychaetes and amphipods of over 600 per square foot.

Massachusetts Bay

Station BH-27 was located just outside the boundary of the Outer Harbor, approximately one-half mile east of one Deer Island wastewater treatment facility outfall. A large number of scavenging isopods were found (2,150 per square foot) in the silt-laden sand of this turbulent reach. Also, many errant polychaetes of the Phyllodocidae family (340 per square foot) and amphipods, *Corophium volutator* (87 per square foot) were found in the bottom sediment. The lack of clean water life such as chitons, brittle-stars, limpet snails, and sea urchins and the presence of the sand-associated polychaetes is suggestive of moderately polluted waters.

A supplementary station BH-45 was located seaward of Boston Harbor in Massachusetts Bay between Green Island and Brewster Island. The clean bottom composed of stone and sand was well covered with such seaweeds as *Fucus* and *Chondrus cripus*. Many brittle-stars (*Ophiopholis aculeata*) were found entwined in the seaweed holdfasts as were the algae associated polychaetes *Nereis pelagica* and *Spirorbis spirillum*. Several predacious Green-Sea urchins (*Strongylocentrotus drobachiensis*) were found hiding among festoons of rock weed. The chiton (*Chaetopleura apiculata*) was found clinging to stones that were covered with the Red Coralline algae. Other forms of life found at this station included amphipods, sowbugs, clams, mussels and snails. The qualitative sample taken at Station BH-45 contained a wide variety of clean water associated animals and plants.

Summary of Benthic Conditions

Results of the 1967 and 1968 benthic surveys show that, in general, Boston Harbor has not changed significantly in its polluted condition since 1967 (see Table 11). Although some local changes have occurred, the degraded benthic environment has persisted. It appears that this situation will not be altered unless pollution loads to the harbor are reduced.

Organically enriched bottom sediments are known to have a high biotic potential. This capability is attained and revealed by certain species of invertebrates in the substratum of Boston Harbor. The prevalence and high numbers of the pollution tolerant sedentary polychaetes,

TABLE 11

BOSTON HARBOR

COMPARISON OF BENTHIC CONDITION

1967 - 1968

STATION		NUMBER OF TYPES OF ORGANISMS		ORGANISMS PER SQUARE FOOT	
1968	1967	1968	1967	1968	1967
BA	H-18	1	1	2,237	4,288
BB	H-3	4	2	316	1,811
BC	H-6	4	5	270	649
BD	H-10	4	3	153	368
BH-06	H-13	6	4	3,040	440
BH-08	H-14	6	4	525	717
BH-13	H-8	5	2	118	120
BH-16	H-9	5	2	45	924
BH-19	H-7	5	3	4,014	772
BH-22	H-11	4	4	3,058	1,602
BH-27	H-17	6	5	2,575	186
BH-37	H-5	7	5	872	490
BH-38	H-1	2	1	327	964
BH-39	H-2	4	2	179	5,365
BH-40	H-4	7	1	65	1,184
BH-41	H-16	7	7	867	573
BH-42	H-16A	7	5	841	286
BH-43	H-19	4	6	219	771
BH-44	H-20	3	2	117	436
BH-45	H-21	13	14	22	14
BH-46	H-12	5	3	3,545	824
BH-47	H-15	9	6	235	280

Polydora ligni and Tharyx acutus, attest to the abundance of organic nutrients in the sediment. The two species of amphipods, Ampelisca macrocephala and Corophium volutator (Appendix C) are also present in considerable numbers at several stations.

In various areas bottom sediments were found to be in an advanced state of decomposition. The large influx of pollutants into the harbor in conjunction with the poor flush rates and low tidal currents prevalent in most of the area allow the deposition of organic matter on the bottom, thus degrading the environment and making it unsuitable for most forms of marine life. In areas of higher tidal velocities where deposition is held to a minimum (Stations BD, BH-08, BH-47, BH-43), environmental conditions remain the same.

Dredging of organic sediment seems to offer a short-range solution to the degraded benthic environment. At Station BH-39, results of the 1967 survey showed a polychaete density of 5,300 per square foot. After dredging operations, the 1968 survey showed a polychaete density of 140 per square foot at this station, which is more compatible to the natural environment. Although this number still approaches the minimum of 200 per square foot reported in the 1967 survey as being indicative of gross pollution, it should be noted that the polychaetes found at this station during the survey are of the free-swimming type usually associated with clean, sandy bottoms.

The constant pollutant sources in Boston Harbor soon redeposit organic sediments on the bottom, thus reverting the benthic conditions to the degraded situation present before dredging.

Massachusetts Water Quality Standards includes the following:

> "4. The waters shall be substantially free
> of pollutants that will:
> (1) unduly affect the composition
> of bottom fauna
> (2) unduly affect the physical or
> chemical nature of the bottom
> (3) interfere with the spawning of
> fish or their eggs--"

Taking the above criteria into consideration, it would appear that from a benthic standpoint the water quality standards are not being met in Boston Harbor.

Phytoplankton

Forty-one stations in Boston Harbor were sampled intermittently for phytoplankton from May to September 1968. During this time, six separate sampling periods were established and various stations sampled during each survey (see Table 12). Except for Station BA, no stations were repeatedly sampled during all six surveys. Therefore, no accurate trends in planktonic variations can be determined from the data.

During the first survey in May, Stations BA, BB, BC and BD were each sampled fifteen times. Average densities of phyto- and zoo-plankton are shown in Figure 14. As can be seen, Station BD demonstrated

TABLE 12

PLANKTON COLLECTION

BOSTON HARBOR

1968

SURVEY	DATES	STATIONS	NO. OF SAMPLES/STATION
1	5/21 - 23	BA, BB, BC, BD	15
2	7/25 - 31	BA, BB, BC, BD, BH-1 thru BH-12	1
3	7/30 - 8/1	BA, BB, BC, BD, BH-13 thru BH-25	1
4	8/6 - 8	BA, BB, BC, BD	6
5	8/13 - 15	BA, B-26-37	6
6	9/24 - 26	BA, B-26-37	3

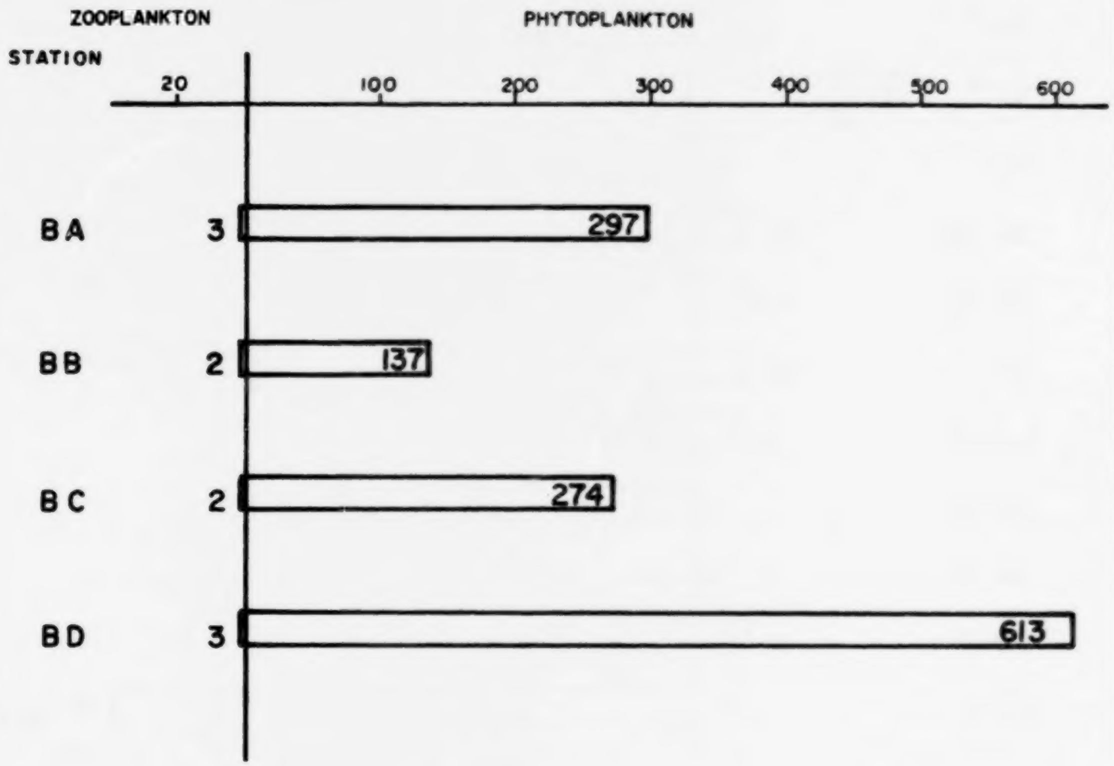
phytoplankton densities of 600 cells per ml. Although this number is not above the minimum density considered to be a bloom (1,000 cells per ml), it is more than twice the number found in Stations BA, BB and BC. Higher nutrient concentrations, present during all tidal phases, may account for this apparent increase in phytoplankton during the May sampling period.

Stations BA, BB, BC, BD and BH-1 through 12 were sampled once during the last week in July. Counts at all stations were low except at BH-18, BH-20 and BH-21 where cell concentrations were 700, 1,600 and 1,400 cells per ml, respectively (see Figure 15). These results are based on only one sample and may not be representative.

From August 6 to August 8, 1968, Stations BA, BB, BC, and BD were again sampled. Average results of six samples per station are shown in Figure 16. Plankton densities were extremely low at all stations, ranging from less than 100 cells per ml at Station BA to more than 230 cells per ml at Station BD. Low concentrations of plankton such as these are indicative of good water quality, but are inconsistent with higher results that would be expected due to the seasonal temperature advance.

Stations BA and BH-26 through BH-37 were sampled six times during the second week in August, and all stations showed phytoplankton cell concentrations of greater than 700 cells per ml (see Figure 17). Results ranged from 710 cells per ml at Station BH-33 to 1,250 cells per ml at Station BH-30. High concentrations of phytoplankton such as these are indicative of nutrient loading of the water, although seasonal variations could play a role in increasing phytoplankton numbers.

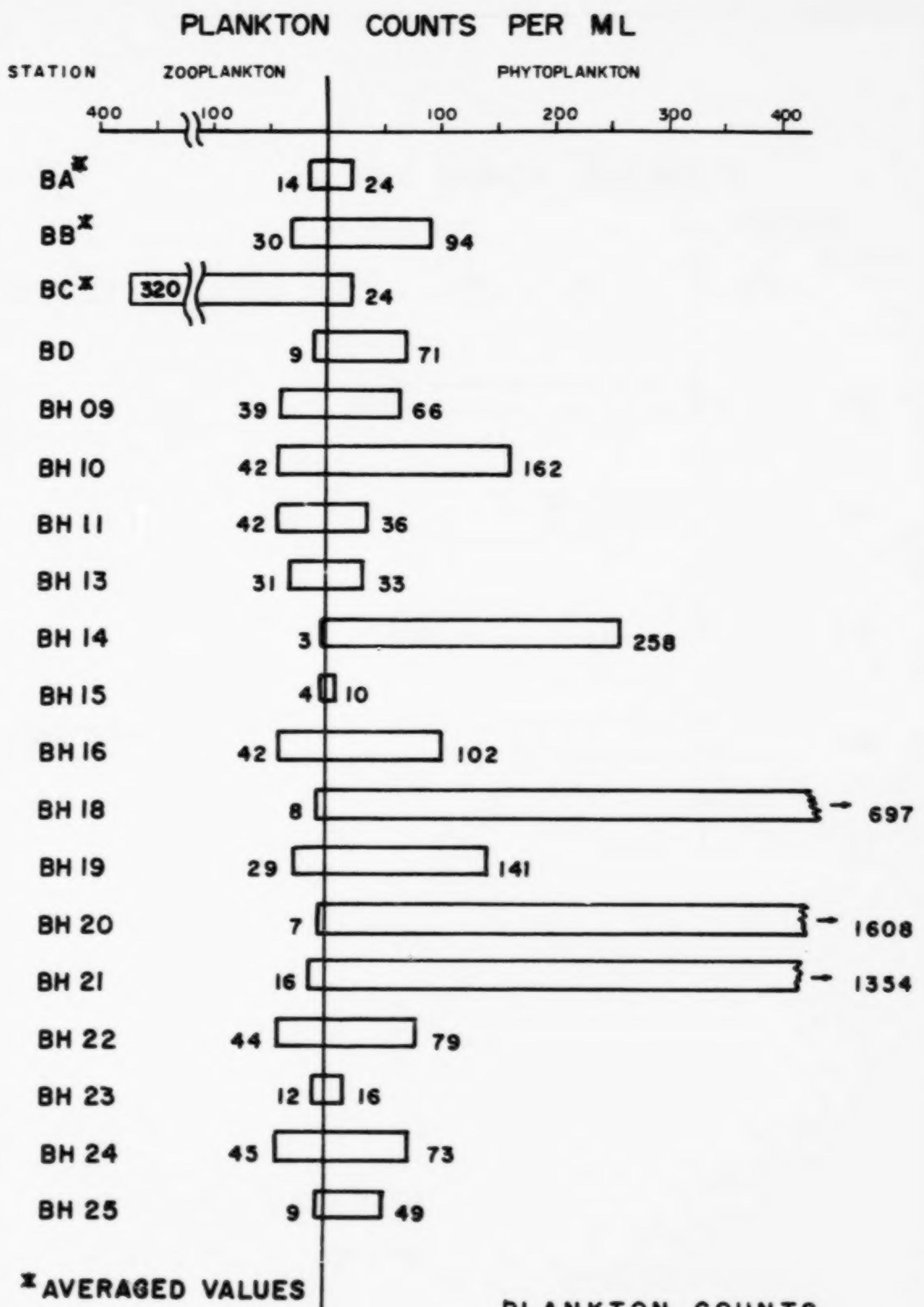
PLANKTON COUNTS PER ML



MEAN PLANKTON COUNTS

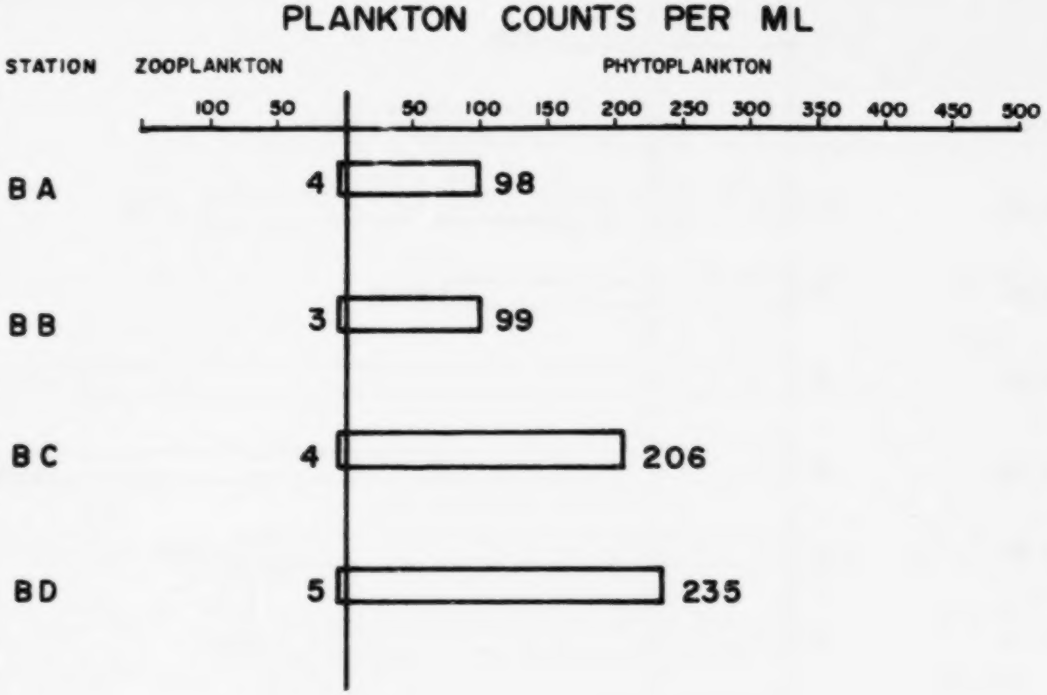
5/21/68 thru 5/23/68

FIGURE 14



PLANKTON COUNTS
7/23/68 thru 8/1/68

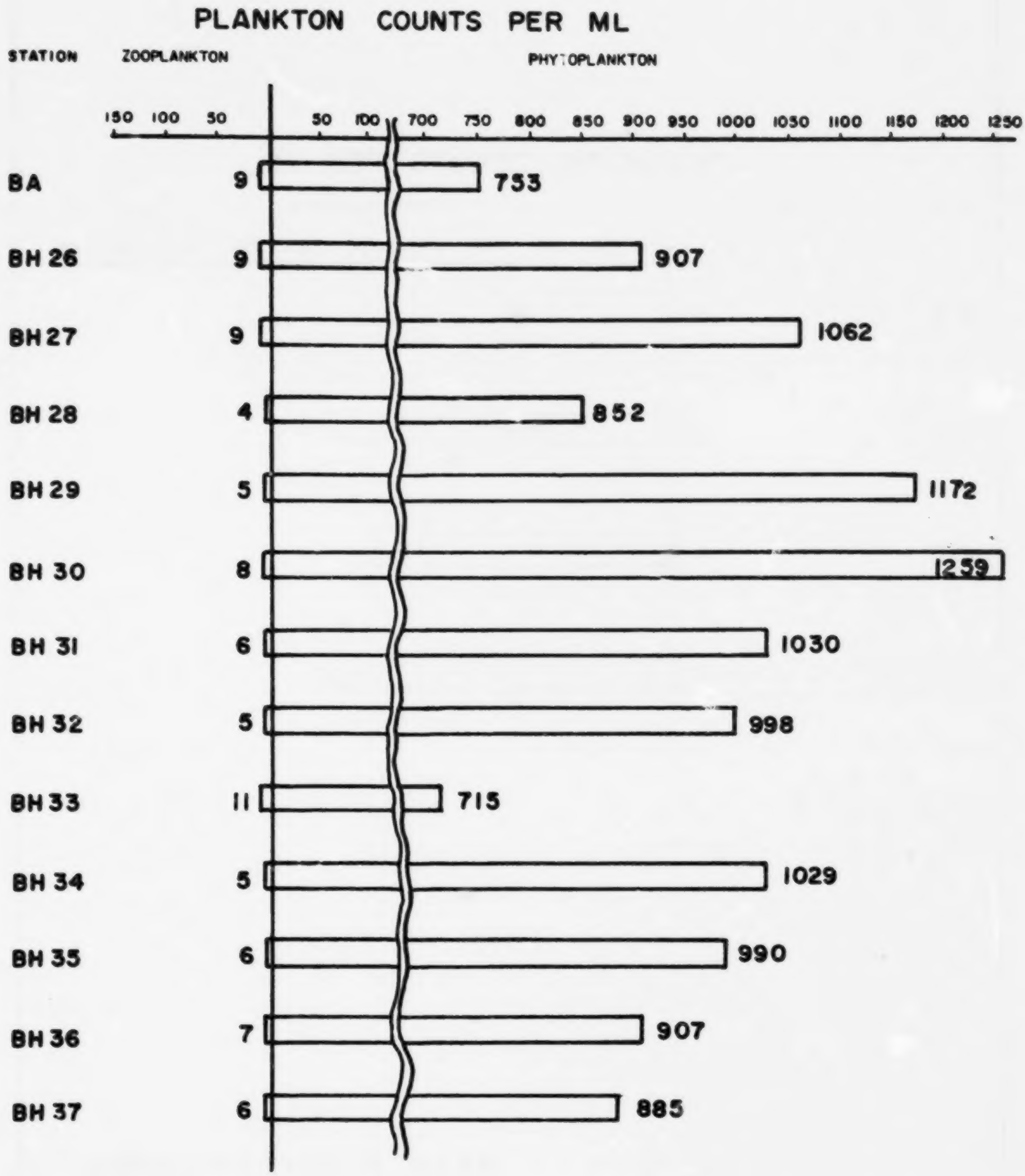
FIGURE 15



MEAN PLANKTON COUNTS

8/6/68 thru 8/8/68

FIGURE 16



MEAN PLANKTON COUNTS

8/13/68 thru 8/15/68

FIGURE 17

During the fourth week of September, Stations BA and BH-27 to BH-37 were once again sampled (see Figure 18). Results of this survey showed low plankton concentrations, the maximum of 260 cells per ml occurring at Station BA. These low results disagree with results of the August survey and are consistent with concentrations one would expect to find in water of good quality with limited nutrient supplied. Samples were obtained at the two foot depth which very possibly was not the optimum depth to sample for the greatest concentration of algae.

Ecology

Identification of plankton indicated a normal seasonal dominance of the population by Chaetoceros sp. This diatom was replaced somewhat by Rhizosolenia sp. and Nitzschia sp. during the fall sampling indicating a species replacement that is normal with seasonal variations. All of these diatoms utilize nutrients such as phosphates and nitrates in their metabolic processes, but concentrations of the organisms found in the harbor do not indicate that nutrients are present in excessive amounts. Individual species distribution cannot be accurately determined with the present data.

Plankton data collected from Boston Harbor during 1968 is insufficient to draw firm conclusions concerning phytoplankton concentration in the harbor, although some indications of excessive densities are present. To expedite the sampling procedures, the plankton samples were taken at a two foot depth. Since plankton density varies with depth and light penetration of the water, other depths might have yielded higher values. This may account for the low values found in Boston Harbor. In order to fully evaluate the trends of planktonic growth in Boston Harbor and to validly report on actual conditions, at least a one-year surveillance program should be conducted on a bi-weekly or monthly basis. This program should include selected stations from Boston Harbor to be sampled at different depths for planktonic and nutrient parameters and also stations outside of Boston Harbor, in Massachusetts Bay, to serve as a baseline for normal seasonal variations in Massachusetts coastal waters. This type of survey would provide information on variations in Boston Harbor plankton due to nutrient additions in relation to normal seasonal variations in shallow water areas.

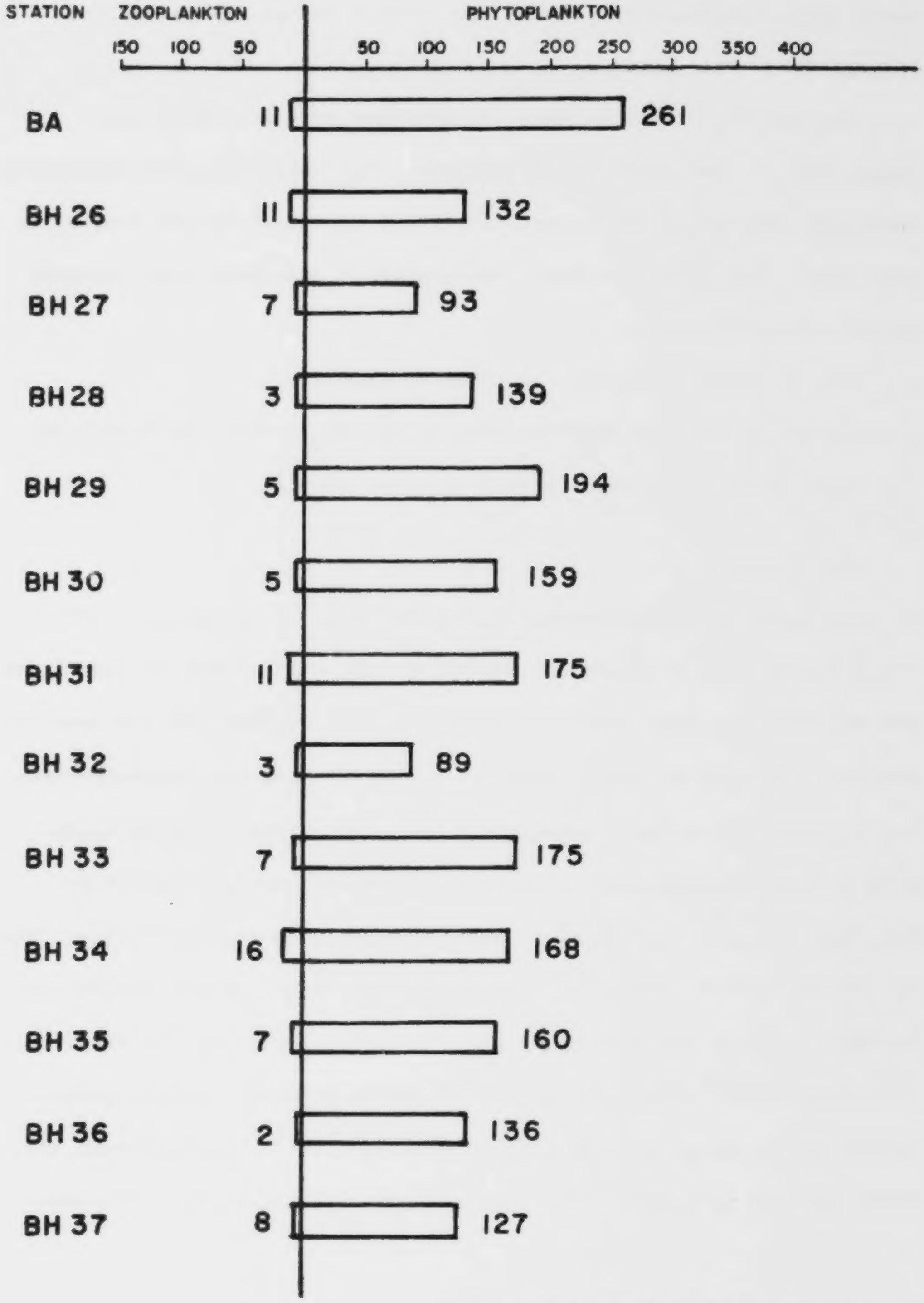
NUTRIENT CONDITIONS

Two of the chemical parameters in the Water Quality Standards for Massachusetts(3) are Phosphate and Nitrogen.

The phosphorus measured by the laboratory was the total orthophosphate and will be designated as PO_4 throughout this report. The Nitrogen measured was the Nitrate Nitrogen and will be designated as NO_3-N. Both nutrients were measured in accordance with the Official FWPCA Interim Methods Manual.(7) The Massachusetts Water Quality Standards are written to total phosphate phosphorous and ammonia nitrogen.

It was predetermined in the planning of this survey that four stations, designated as BA, BB, BC, and BD would be used to chemically characterize Boston Harbor. Since these stations were intensively sampled at all tidal stages, the total averages of the PO_4 and NO_3-N tests were used in characterizing the harbor.

PLANKTON COUNTS PER ML



MEAN PLANKTON COUNTS
9/24/68 thru 9/26/68

FIGURE 18

In studying the chemical effects of the Deer Island and Nut Island waste water treatment facilities upon Boston Harbor, Stations BH-1 through BH-37 were used.

PO_4 and NO_3-N data at these 37 stations were separated into "high tide" - "low tide" concentrations. The term high tide designates that time interval between one hour before high tide to one hour after high tide. The term "low tide" designates an analogous time interval at the low tide cycle.

Raw data printouts are presented in Appendix B.

Tables 13 and 14 summarize the PO_4 and NO_3-N data for high tide, low tide and total average for all stations sampled.

Phosphorus

Table 15 lists the average value and range of phosphorus (P), found in PO_4, for Stations BA, BB, BC and BD, while Table 13 summarizes the PO_4 data for high tide, low tide and total average for all stations sampled. Figures 19 and 20 show the average PO_4 harbor concentrations for high and low tides, respectively, at each of the stations where such a value was obtained. Stations BA, BB, BC and BD show nearly the same range of phosphorus. In determining the significance of these concentrations of phosphorus, it is worthwhile to compare the values in Table 15 with concentrations of phosphorus published for other bays.

Jeffries(13) cites Raritan Bay as having a season mean phosphorus concentration range of 0.06 mg/l to 0.14 mg/l as P. Narragansett Bay, Rhode Island, is cited(17) as having a mean concentration of between

TABLE 13

AVERAGE TOTAL ORTHOPHOSPHATE

STATION NO.	AVERAGE HIGH TIDE mg/l as PO_4	AVERAGE LOW TIDE mg/l as PO_4	AVERAGE ALL SAMPLES mg/l as PO_4
BA	0.17	0.18	0.17
BB	0.19	0.21	0.19
BC	0.16	0.23	0.20
BD	0.20	0.23	0.19
BH-1	-	-	0.39
BH-2	-	-	0.29
BH-3	-	-	0.26
BH-4	-	-	0.34
BH-5	-	-	0.19
BH-6	-	0.19	0.19
BH-7	-	0.23	0.23
BH-8	-	-	0.23
BH-9	-	0.16	0.16
BH-10	-	-	0.16
BH-11	-	-	0.29
BH-12	-	-	0.36
BH-13	0.24	0.24	0.23
BH-14	0.24	0.26	0.24
BH-15	0.24	0.22	0.23
BH-16	0.18	0.18	0.18
BH-17	0.17	0.19	0.18
BH-18	0.80	0.51	0.65
BH-19	0.18	0.18	0.17
BH-20	0.12	0.15	0.13
BH-21	0.18	0.18	0.18
BH-22	-	0.22	0.21
BH-23	-	0.24	0.23
BH-24	-	0.27	0.26
BH-25	-	0.26	0.26
BH-26	0.25	0.27	0.26
BH-27	0.14	0.21	0.16
BH-28	0.16	0.18	0.16
BH-29	0.16	0.19	0.17
BH-30	0.14	0.24	0.16
BH-31	0.20	0.24	0.19
BH-32	0.18	0.19	0.17
BH-33	0.21	0.18	0.20
BH-34	0.18	0.18	0.19
BH-35	0.17	0.18	0.17
BH-36	0.18	0.27	0.18
BH-37	0.21	0.29	0.21

TABLE 14

AVERAGE NITRATE NITROGEN

STATION NO.	AVERAGE HIGH TIDE mg/1 NO_3-N	AVERAGE LOW TIDE mg/1 NO_3-N	AVERAGE ALL SAMPLES mg/1 NO_3-N
BA	0.07	0.10	0.08
BB	-	0.06	0.07
BC	0.06	-	0.06
BD	0.09	0.05	0.06
BH-1	-	-	0.05
BH-2	-	-	0.04
BH-3	-	-	0.06
BH-4	-	-	0.03
BH-5	-	-	-
BH-6	-	-	0.05
BH-7	-	-	0.05
BH-8	-	-	0.04
BH-9	-	-	0.06
BH-10	-	-	0.04
BH-11	-	-	0.04
BH-12	-	-	0.05
BH-13	0.04	0.06	0.06
BH-14	0.04	0.08	0.07
BH-15	0.09	0.07	0.08
BH-16	0.08	0.06	0.06
BH-17	0.07	0.08	0.07
BH-18	0.08	0.07	0.08
BH-19	0.07	0.08	0.07
BH-20	0.07	0.06	0.06
BH-21	0.08	0.08	0.07
BH-22	-	0.06	0.06
BH-23	-	0.06	0.06
BH-24	-	0.06	0.06
BH-25	-	0.04	0.06
BH-26	0.08	0.08	0.07
BH-27	0.08	0.11	0.08
BH-28	0.08	0.09	0.08
BH-29	0.09	0.09	0.08
BH-30	0.10	0.09	0.08
BH-31	0.08	0.09	0.07
BH-32	0.08	0.06	0.17
BH-33	0.09	0.07	0.07
BH-34	0.08	0.06	0.07
BH-35	0.08	0.07	0.07
BH-36	0.10	0.13	0.08
BH-37	0.08	0.09	0.07

TABLE 15

AVERAGE CONCENTRATION AND RANGES OF TOTAL ORTHOPHOSPHATE PHOSPHOROUS AT ALL TIDAL CYCLES

STATION	AVERAGE	RANGES
BA	0.06 mg/l as P	0.04 -- 0.10 mg/l as P
BB	0.06 mg/l as P	0.04 -- 0.10 mg/l as P
BC	0.06 mg/l as P	0.05 -- 0.10 mg/l as P
BD	0.06 mg/l as P	0.04 -- 0.09 mg/l as P

TABLE 16

AVERAGE CONCENTRATION AND RANGES OF NITRATE-NITROGEN AT ALL TIDAL CYCLES

STATION	AVERAGE	RANGES
BA	0.08 mg/l as N	0.03 -- 0.29 mg/l as N
BB	0.07 mg/l as N	0.05 -- 0.10 mg/l as N
BC	0.06 mg/l as N	0.04 -- 0.09 mg/l as N
BD	0.06 mg/l as N	0.04 -- 0.09 mg/l as N

0.03 mg/l through 0.05 mg/l as P, while the lower Chesapeake Bay has been found to(16) have a phosphorus range from essentially zero to 0.07 mg/l as P.

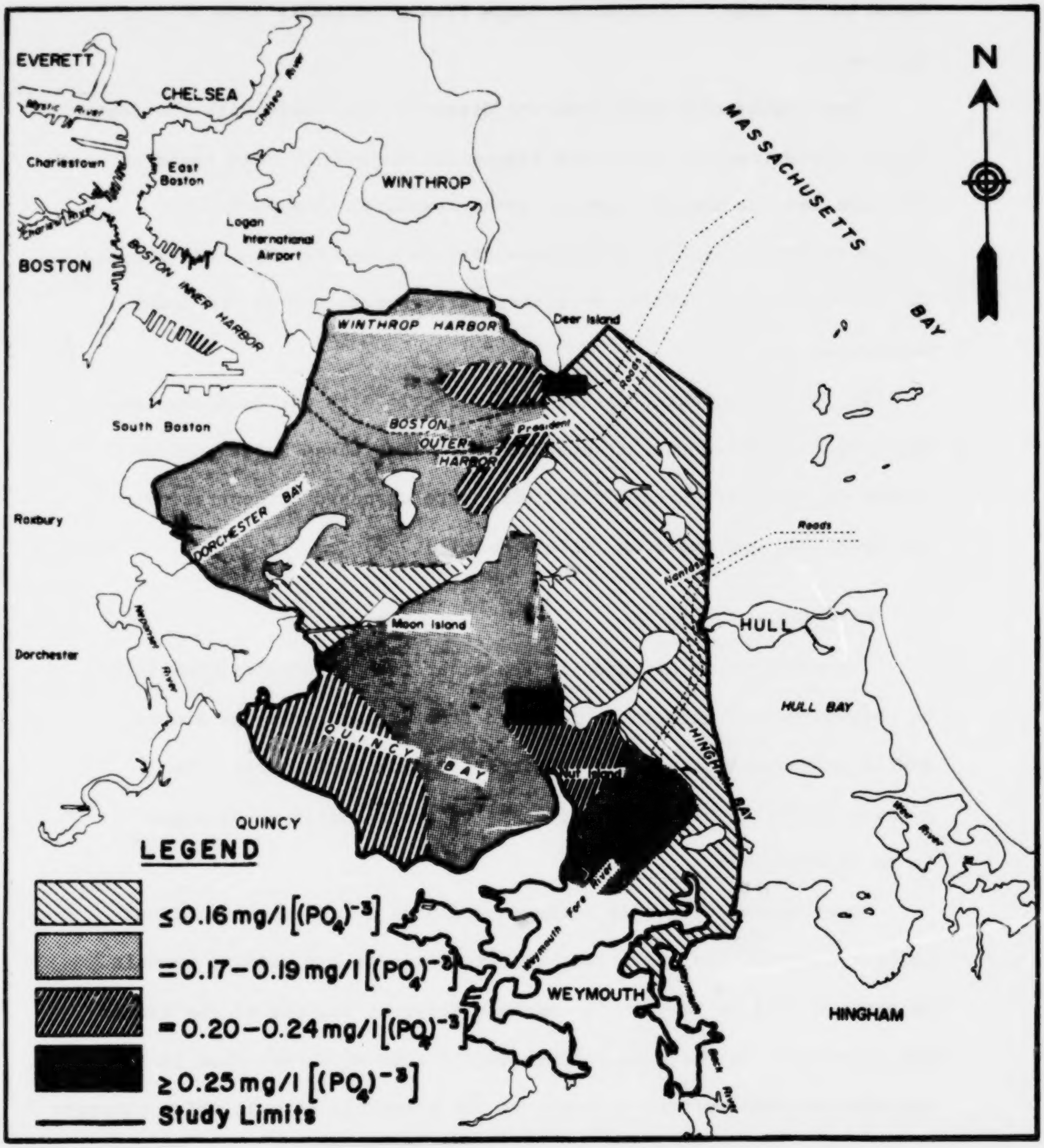
These cited concentrations are directly comparable with the Boston Harbor concentrations since the values of phosphours were based on the same test parameter, namely, orthophosphate. The phosphorus ranges of Boston Harbor waters more closely resemble those of Raritan Bay waters than the waters of either Narragansett Bay or the Lower Chesapeake Bay.

In comparing Boston Harbor data directly with the Massachusetts Water Quality Standards, it must be noted that these Water Quality Standards are written to a total phosphate standard concentration of not more than 0.07 mg/l as phosphorus (P).

Nitrogen

The presence of nitrogen in sea water is more complex than that of phosphorous. Nitrogen is released from organic forms as ammonia and is subsequently oxidized to nitrite thence to nitrate. The nitrate may be then used by organisms to appear again as nitrogen in an organic form.

Superimposed upon this nitrogen cycle is a seasonal biological cycle. Cooper(4) has shown that in temperate coastal waters, ammonia is present only in very small concentrations at the end of the winter and increases, as the summer advances, to such an extent that it is not uncommon to find ammonia nitrogen as the principle form in which nitrogen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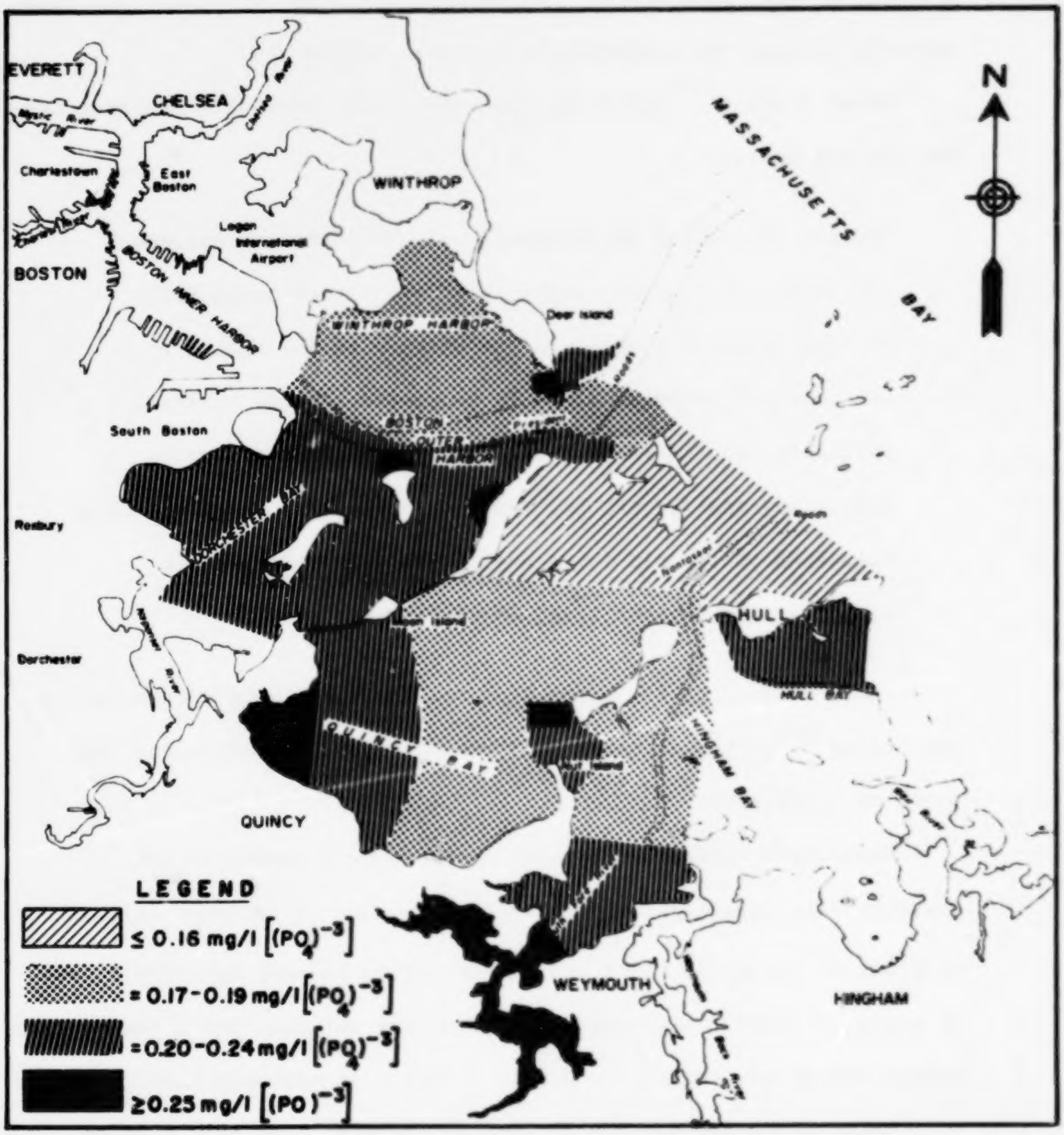
EVERETT
CHELSEA
Mystic River
Chelsea River
Charlestown
East Boston
WINTHROP
MASSACHUSETTS BAY
Logan International Airport
BOSTON
Charles River
BOSTON INNER HARBOR
WINTHROP HARBOR
Deer Island
South Boston
BOSTON OUTER HARBOR
President Roads
DORCHESTER BAY
Roxbury
Nantasket Roads
Moon Island
HULL
Dorchester
Neponset River
HULL BAY
QUINCY BAY
HINGHAM BAY
QUINCY
Weir River
Weymouth Fore River
WEYMOUTH
HINGHAM
Back River
LEGEND
≤ 0.16 mg/l [(PO4)-3]
= 0.17 – 0.19 mg/l [(PO4)-3]
= 0.20 – 0.24 mg/l [(PO4)-3]
≥ 0.25 mg/l [(PO4)-3]
Study Limits

BOSTON HARBOR

MEAN TOTAL
ORTHOPHOSPHATE CONCENTRATIONS
HIGH TIDE
SUMMER 1968

FIGURE 19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Deer Island
MASSACHUSETTS BAY
N
South Boston
BOSTON OUTER HARBOR
DORCHESTER BAY
Roxbury
Dorchester
Moon Island
QUINCY BAY
QUINCY
HULL
HULL BAY
HINGHAM BAY
WEYMOUTH
HINGHAM
LEGEND
▨ $\leq$ 0.16 mg/l $[(PO_4)^{-3}]$
▒ = 0.17-0.19 mg/l $[(PO_4)^{-3}]$
▧ =0.20-0.24mg/l $[(PO_4)^{-3}]$
■ $\geq$0.25 mg/l $[(PO)^{-3}]$

BOSTON HARBOR
MEAN TOTAL
ORTHOPHOSPHATE CONCENTRATION
LOW TIDE
SUMMER 1968

FIGURE 20

exists at the height of the season. In addition, Harris(12) has found that when ammonia nitrogen is present, with little or no nitrate nitrogen available, some phytoplankton may utilize the ammonia form of nitrogen directly without the oxidation to nitrite and nitrate.

Other studies(20) state the following with respect to San Francisco Bay and the Delta:

> "During the period May-October, organic forms (of nitrogen) are typically dominant and at times represent essentially all the nitrogen present in the water with the exception of dissolved nitrogen gas.--In conclusion, based on available data, the nitrogen available as a plant nutrient in Sussan Bay and Western Delta waters appears to be effectively converted to organic forms during the late spring-early summer at the present level of enrichment."

Therefore, it is not surprising to find that "pure" ocean waters are listed(19) as having nitrate-nitrogen, NO_3-N, concentration from 0.001 to 0.600 mg/l.

Appendix E presents two water analyses data sheets of the Massachusetts Department of Public Health. One is for Deer Island effluent on August 28, 1968 and the second is for Nut Island effluent on August 7, 1968. This data shows that the effluent being pumped into Boston Harbor may range from 0.0 to 0.9 mg/l of nitrogen as NO_3-N.

Table 14 summarizes the NO_3-N data for high tide, low tide and total average for all stations sampled. Average NO_3-N concentrations at high and low tide are presented in Figures 21 and 22 for each of the stations sampled.

Based upon the data collected in the 1968 Boston Harbor Study, it is difficult to state whether the nitrate nitrogen concentrations found were due to either a lack of biological activity to convert the nitrate back to organic forms, or the introduction of nitrogen to the harbor from point sources such as rivers, outfalls or from organically rich sediments and mudflats which are decomposing.

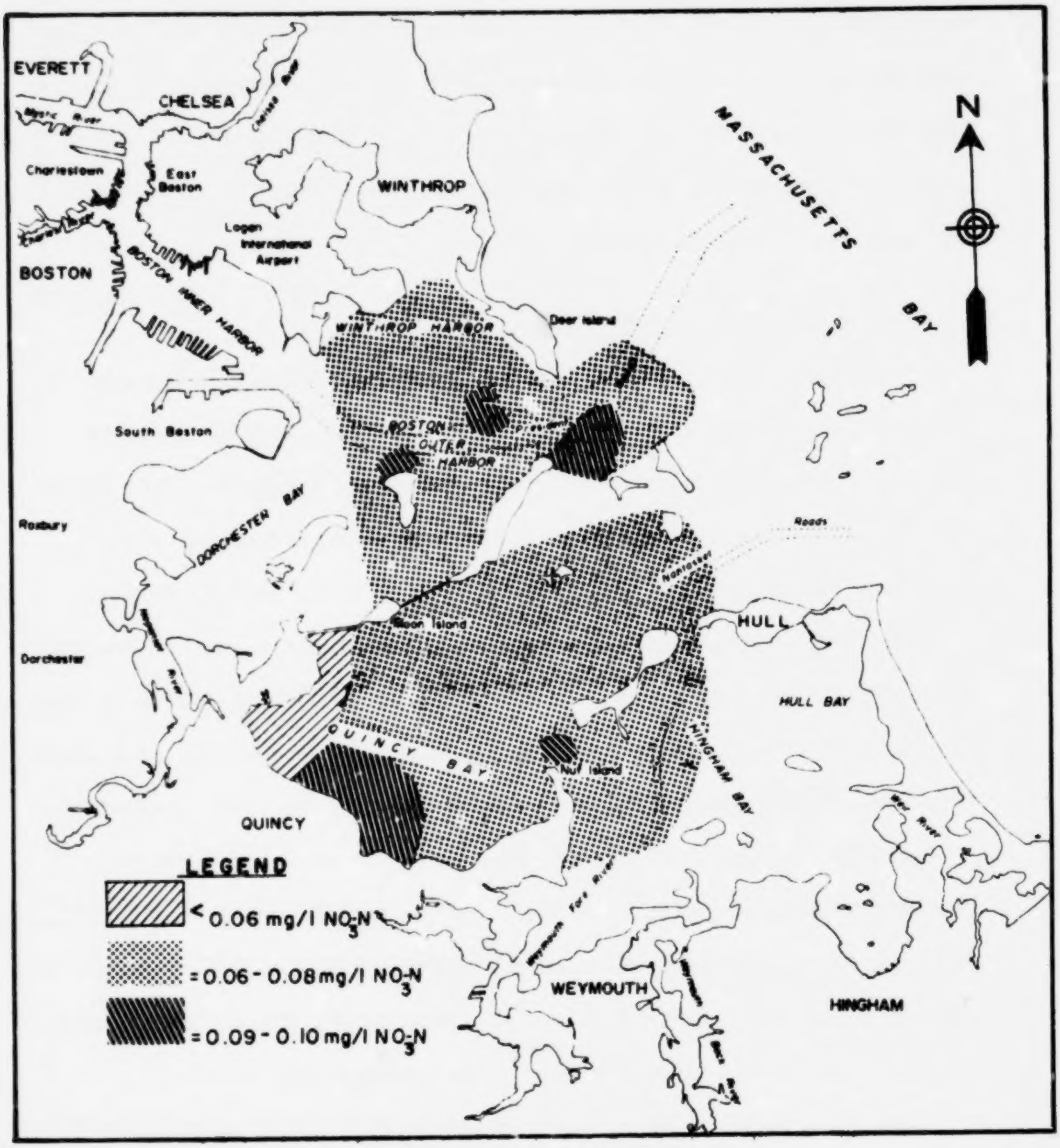
Effects of Sewage Discharges

Figure 19 (High Tide PO_4 Concentrations) is density-coded and indicates a directional tailing of phosphate concentration from the outfall of the Deer Island waste water treatment facility. This would indicate that there is a current during the flood tide cycle which carries effluent from the Deer Island outfall into Winthrop Harbor.

There is another tailing effect which indicates a current flowing during the flood tide cycle from the effluent outfall of Nut Island into Hingham Bay. The southwest portion of Quincy Bay appears to be a slack water area since the PO_4 values are very high and of similar magnitude.

Figure 20 (Low Tide PO_4 Concentrations) shows large areas of homogenous phosphate distribution in Boston Harbor with a tailing effect from the Deer Island outfall toward Massachusetts Bay. This phosphate tailing would again indicate a current flow during the ebb tidal cycle from the end of Deer Island towards Massachusetts Bay.

The pronounced large homogenous areas of high phosphate concentrations imply both a mixing of the harbor by tidal action and a pollution of the harbor bottom.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N
WINTHROP HARBOR
Deer Island
South Boston
BOSTON OUTER HARBOR
Roxbury
DORCHESTER BAY
Roads
Nantasket
Moon Island
HULL
Dorchester
Neponset River
HULL BAY
QUINCY BAY
Nut Island
HINGHAM BAY
Weir River
QUINCY
LEGEND
▨ < 0.06 mg/l NO_3-N
▒ = 0.06 - 0.08 mg/l NO_3-N
▩ = 0.09 - 0.10 mg/l NO_3-N
Weymouth Fore River
WEYMOUTH
Back River
HINGHAM

BOSTON HARBOR

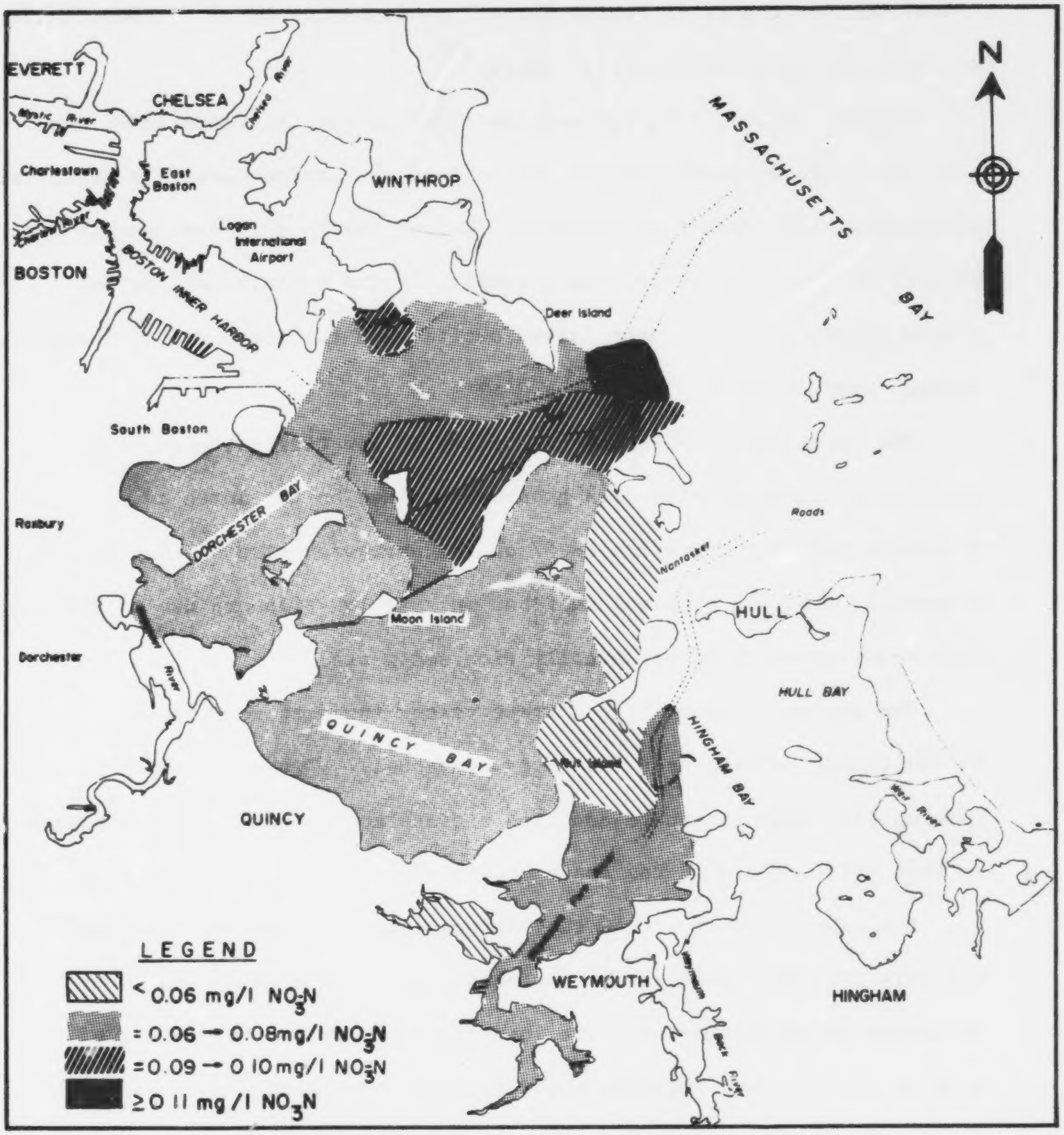
MEAN

NITRATE-NITROGEN CONCENTRATION

HIGH TIDE

SUMMER 1968

FIGURE 21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BOSTON INNER HARBOR
Deer Island
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DORCHESTER BAY
Roxbury
Roads
Nantasket
HULL
Moon Island
Dorchester
River
HULL BAY
QUINCY BAY
HINGHAM BAY
QUINCY
Weir River
WEYMOUTH
Back River
HINGHAM
LEGEND
▨ < 0.06 mg/l NO3-N
▒ = 0.06 → 0.08mg/l NO3-N
▨ =0.09 → 0.10mg/l NO3-N
■ ≥0.11 mg/l NO3-N

BOSTON HARBOR
MEAN
NITRATE - NITROGEN CONCENTRATION
LOW TIDE
SUMMER 1968

FIGURE 22

Figures 19 and 20 indicate certain water currents and slack water areas in Boston Harbor which do indeed exist and are shown by the "Tidal Current Charts of Boston Harbor" published by the U. S. Department of Commerce, Coast and Geodetic Survey.(5)

Figures 21 and 22, (High and Low Tide Nitrate Concentrations) show that the nitrate concentrations are uniform and Boston Harbor is essentially homogenous with respect to nitrates. Exceptions to this homogeneity are at certain locations at low tide, namely, in the vicinity of the Nut Island sludge outfall - Deer Island outfall and the north end of Spectacle Island (Station BH-36).

The locations of high nitrate values at low tide coincide with location of exceptionally high phosphate values on the north end of Spectacle Island and Station BH-37 on the northwest side of Long Island, suggesting that the high values found only at low tide are due to leaching from heavy deposits of organically rich sediments.

The maximum area of high nitrate values found at low tide is in the sludge outfall area, as noted previously. Two other areas showing both high phosphate and high nitrate concentrations are contiguous to this area and are on the Inner Harbor side.

Both the phosphorus and the nitrogen results indicate that the outfalls from the waste water treatment plants are a major source of pollution of Boston Harbor. The location of major concentrations of both phosphorus and nitrogen would indicate that sludge outfalls are discharging on the incoming or flood tidal cycle. Homogeneous nitrate and phosphate values indicate that the waters of Boston Harbor are well mixed by the tidal action.

RADIOACTIVITY

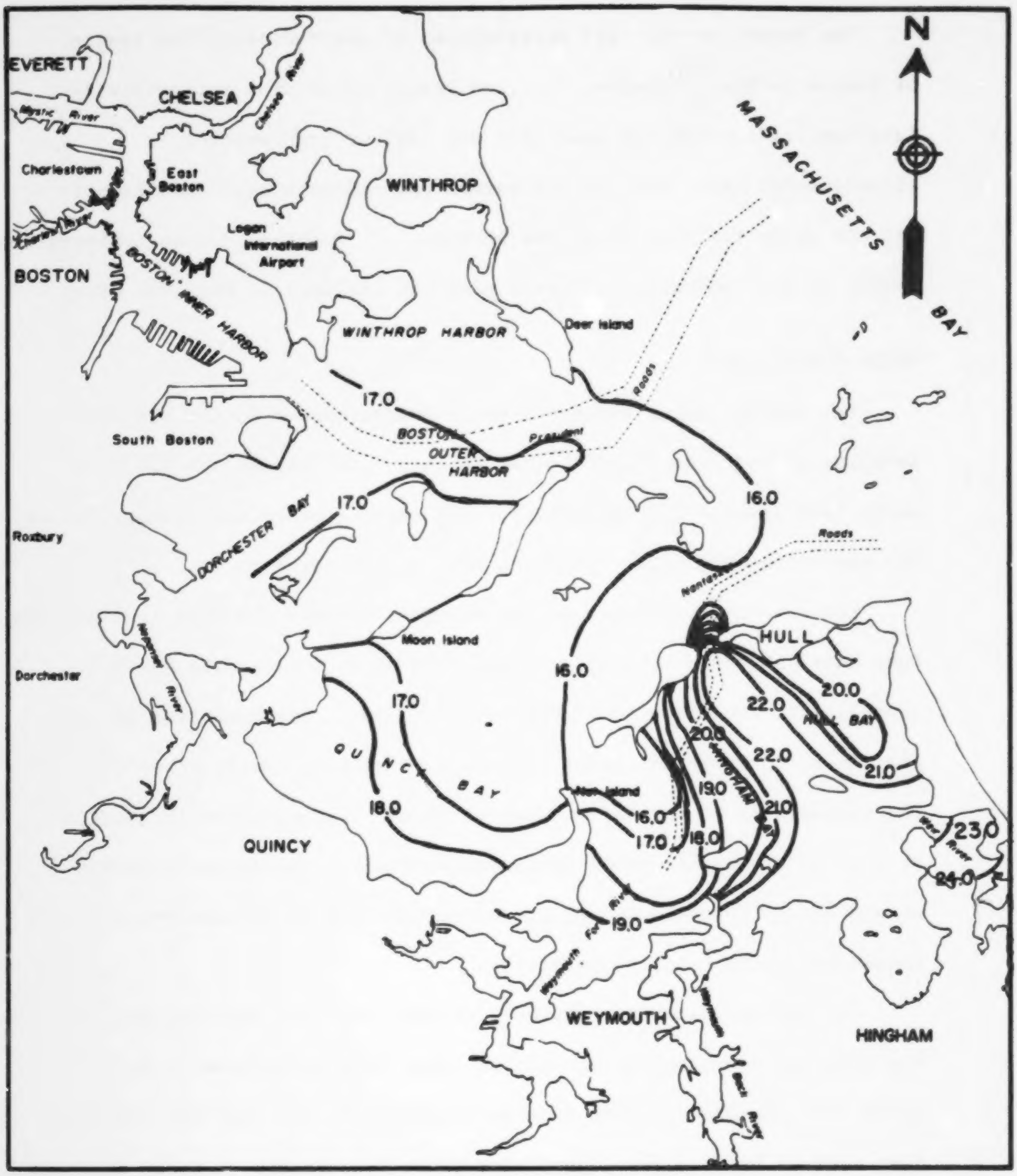
The report of the 1967 observations of the radioactivity levels of Boston Harbor(10) states, "....low levels of natural radioactivity (uranium, radium-226 and lead 210) and fallout (represented by strontium-90) were found in the waters and sediment of Boston Harbor and the major tributaries to the harbor...." For this reason, observation levels of the radioactivity level were not included in the 1968 study.

WATER TEMPERATURE

The average water temperatures in Boston Harbor during the 1968 sampling period from 10.5°C in May to 24.3°C in July at the 2.0 foot depth (see Figures 23, 24 and 25). The average water temperatures along the shoreline were higher than the rest of the harbor.

The water temperatures of the stations between the shoreline and the open water showed a general decrease from warm temperatures along the shoreline to cooler water of Massachusetts Bay. One exception was at Station BH-18 where the water temperatures were generally lower than the temperature of the surrounding stations. This station is located at the end of channel known as Nantasket Roads. The upward movement of the cooler bottom water as it reached the end of the channel probably caused the lower water temperatures.

The average water temperatures at most stations were highest at low tide and decreased as the cooler water from Massachusetts Bay moved into the harbor. One notable exception to this was the stations just west of Deer Island Light. The water temperature at these stations stayed approximately the same during each tidal cycle.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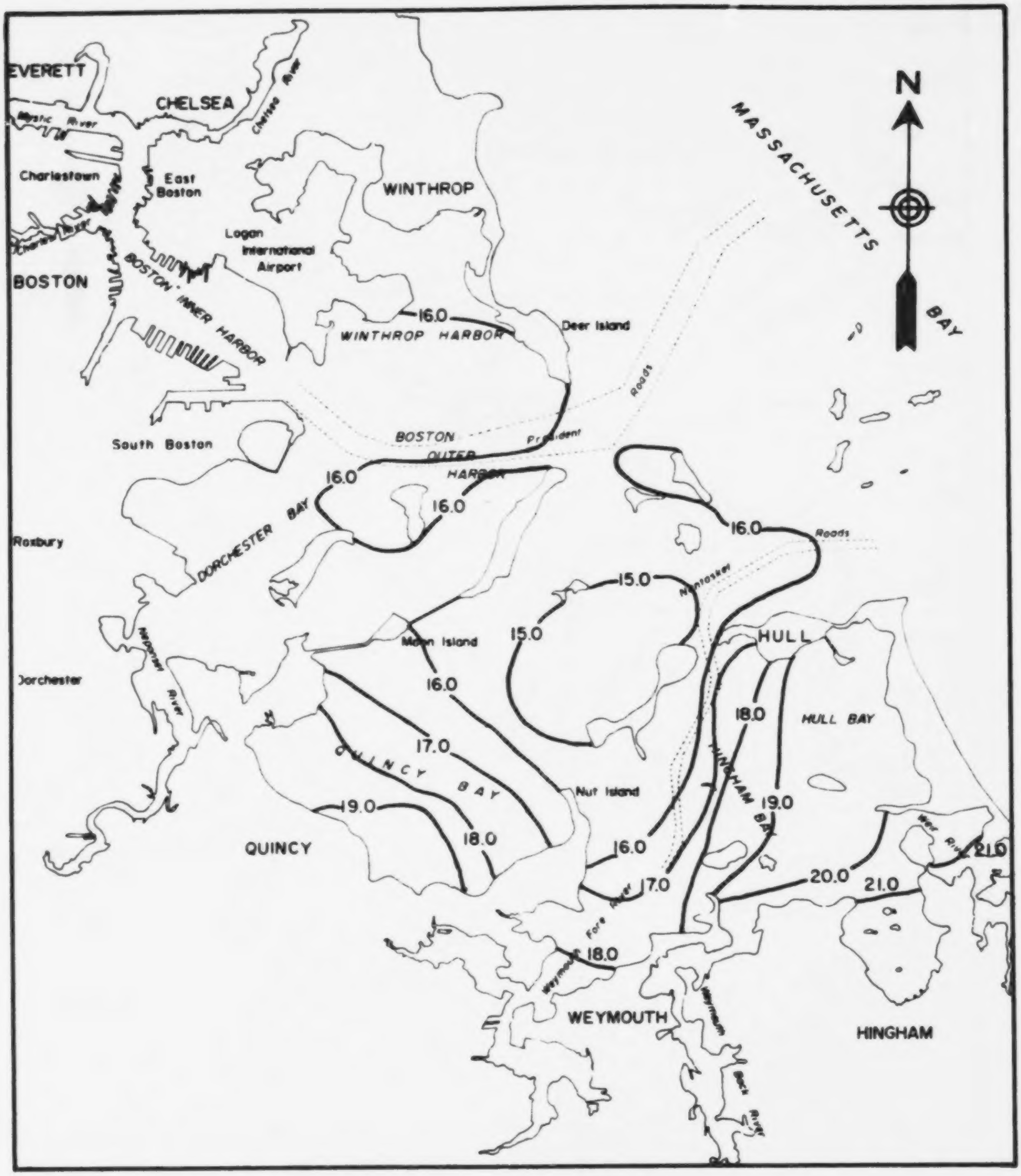
Charles River
Logan International Airport
BOSTON
BOSTON INNER HARBOR
WINTHROP HARBOR
Deer Island
Roads
17.0
BOSTON OUTER HARBOR
President
South Boston
17.0
DORCHESTER BAY
16.0
Roxbury
Roads
Nantasket
HULL
Moon Island
Dorchester
Neponset River
16.0
17.0
20.0
22.0
HULL BAY
20.0
22.0
QUINCY BAY
HINGHAM BAY
21.0
18.0
Nut Island
19.0
21.0
16.0
17.0
18.0
23.0
Weir River
24.0
QUINCY
19.0
Fore River
Weymouth Fore River
WEYMOUTH
Weymouth Back River
HINGHAM

BOSTON HARBOR
TEMPERATURE °C
2.0 FOOT DEPTH
MEAN LOW TIDE

SUMMER 1968

FIGURE 23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WINTHROP HARBOR
Deer Island
President Roads
BOSTON OUTER HARBOR
South Boston
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DORCHESTER BAY
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Roads
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Moon Island
Dorchester
Neponset River
HULL
16.0
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HULL BAY
17.0
QUINCY BAY
HINGHAM BAY
Nut Island
19.0
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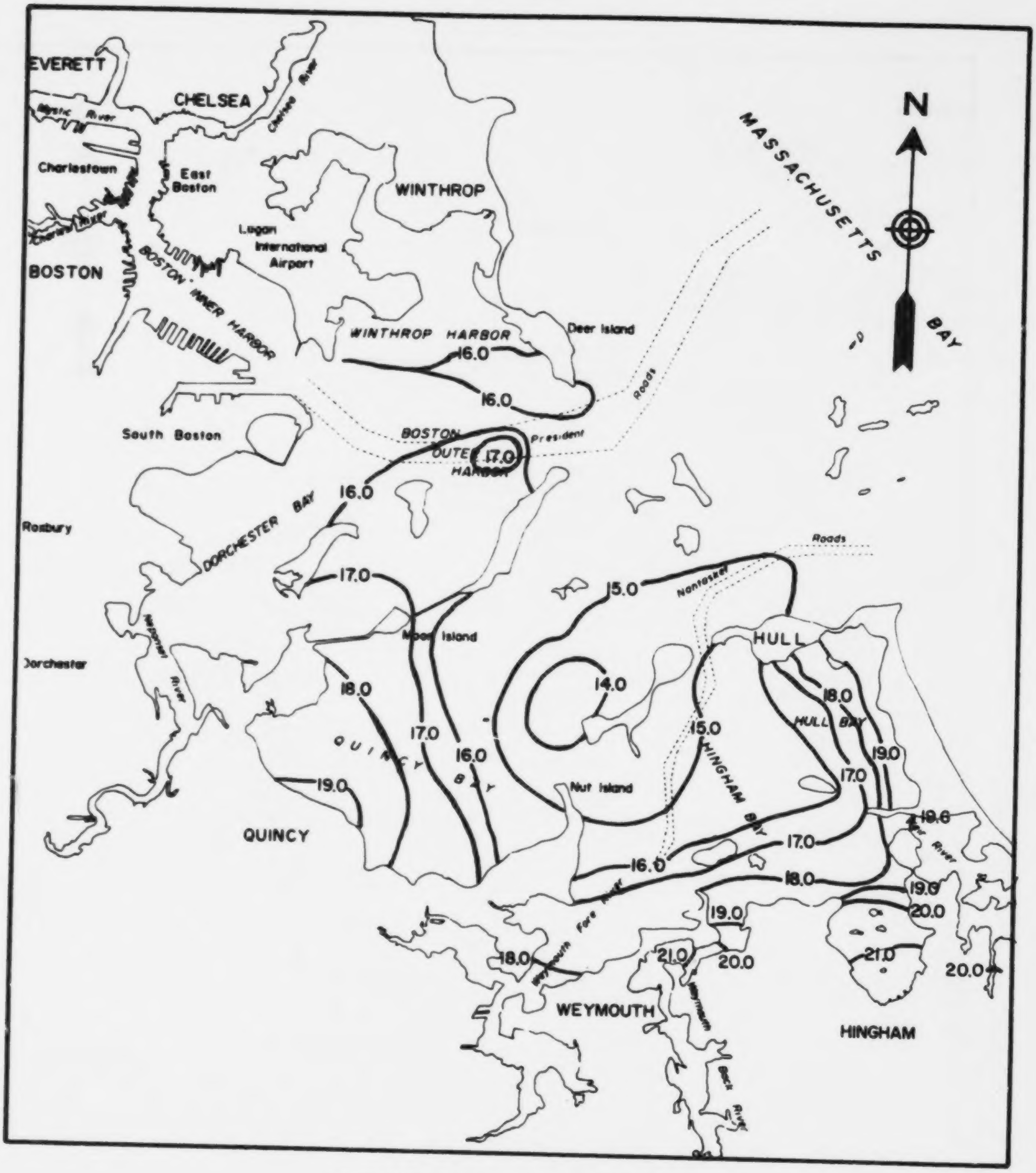
18.0
QUINCY
16.0
Weir River
21.0
17.0
20.0
21.0
Fore River
18.0
Weymouth
WEYMOUTH
Weymouth Back River
HINGHAM

BOSTON HARBOR
TEMPERATURE °C
2.0 FOOT DEPTH
MEAN MID TIDE

SUMMER 1968

FIGURE 24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MASSACHUSETTS BAY
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WINTHROP HARBOR
Deer Island
16.0
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Roads
South Boston
BOSTON OUTER HARBOR
President
17.0
16.0
Roxbury
DORCHESTER BAY
Roads
17.0
15.0
Nantasket
Moon Island
HULL
Dorchester
Neponset River
18.0
14.0
18.0
QUINCY BAY
17.0
16.0
15.0
HULL BAY
19.0
HINGHAM BAY
19.0
Nut Island
17.0
19.6
QUINCY
17.0
Weir River
16.0
18.0
19.0
19.0
20.0
18.0
Weymouth Fore River
21.0
20.0
21.0
20.0
WEYMOUTH
Weymouth Back River
HINGHAM

BOSTON HARBOR
TEMPERATURE °C
2.0 FOOT DEPTH
MEAN HIGH TIDE

SUMMER 1968

FIGURE 25

Twelve sampling stations in 1968 recorded a higher average water temperature than in 1967 (see Figure 26), probably the result of increased solar radiation. The percent of sunshine possible during July and August 1968 was 73 and 69, respectively, as compared with 48 and 54 for July and August of 1967 (see Appendix F).

SALINITY

The salinity in Boston Harbor was generally lowest along the shore line and increased towards the open water (Figures 27, 28 and 29). One exception to this is the water in Quincy Bay along the Wollaston Beach area which was higher than the salinity than would be expected. This suggests that the water in the Wollaston Beach area is not flushed by each tide. The salinity is probably raised by evaporation of the water.

The observed increase in salinity from May to August (Figure 30) was probably a result of the decrease in fresh water influent from Boston Harbor's tributaries during the summer months, along with increased evaporation due to more solar radiation.

The salinities at all comparable stations during 1968 were higher than 1967 (see Figure 31). This could have been the result of the lower rainfall in the area during the period of May through August 1968 when 11.06 inches of rain fell at Logan Airport Weather Bureau Station while during the same period of 1967, 19.01 inches fell (see Appendix F).

WATER CURRENTS IN BOSTON HARBOR

DROGUE OBSERVATIONS

A device called a drogue was used to determine the direction of flow of the surface waters. The drogue, which is 4 feet in depth, was submerged about a half foot, making the bottom of the drogue 4.5 feet beneath the water surface.

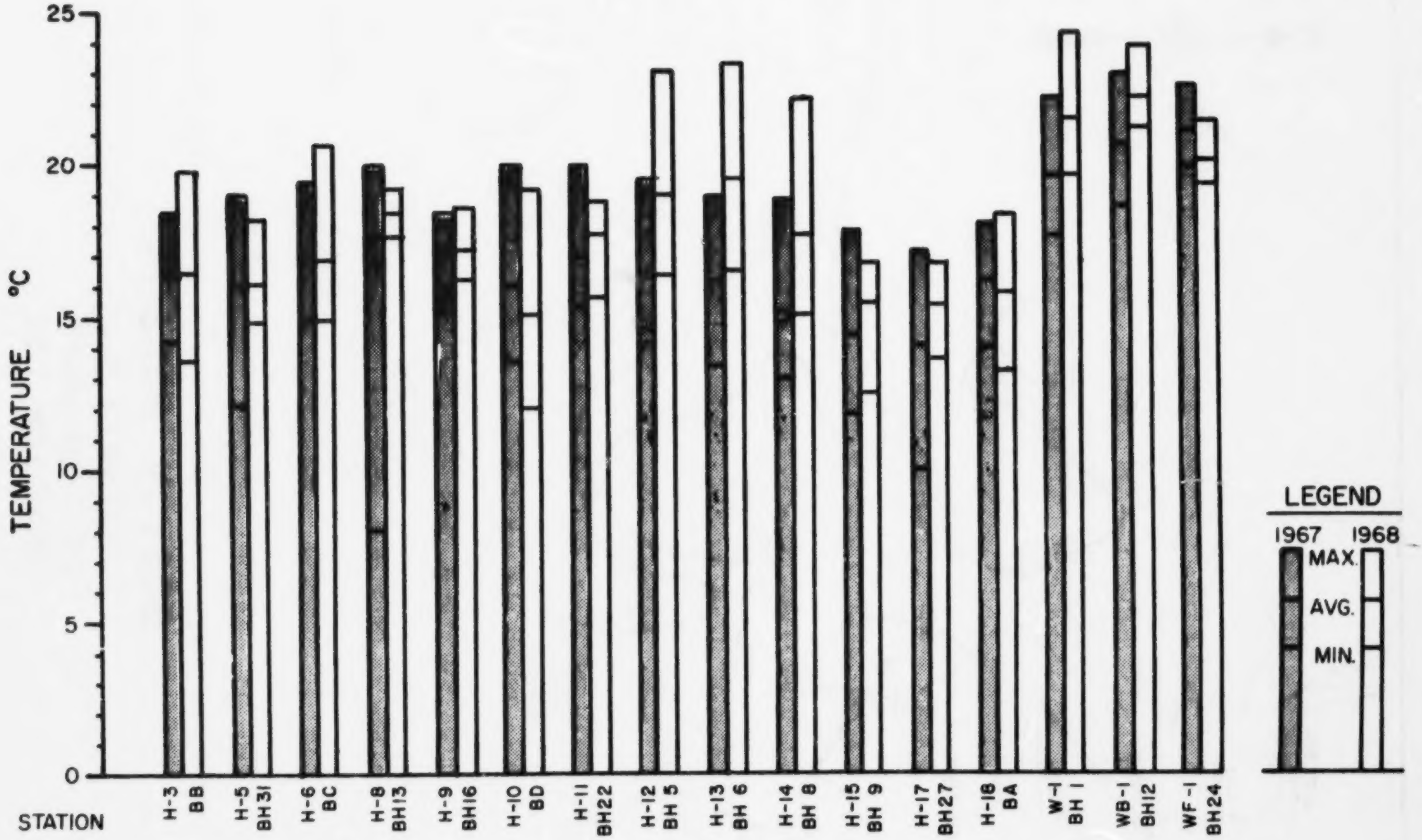
At 8:10 am on October 30, 1968, a drogue was released east of Deer Island in the boil created by the sewage discharged from Deer Island waste water treatment facility. This was approximately an hour and forty-five minutes after high tide and one hour and thirty minutes after slack water. Maximum current occurred two hours after the drogue was released (see Table 1).(6) A 25 knot northwesterly wind was reported most of the day and probably caused the drogue to drift slightly southeast of its path if there was no wind.

TABLE

TIDE TABLE FOR BOSTON HARBOR ON OCTOBER 30, 1968

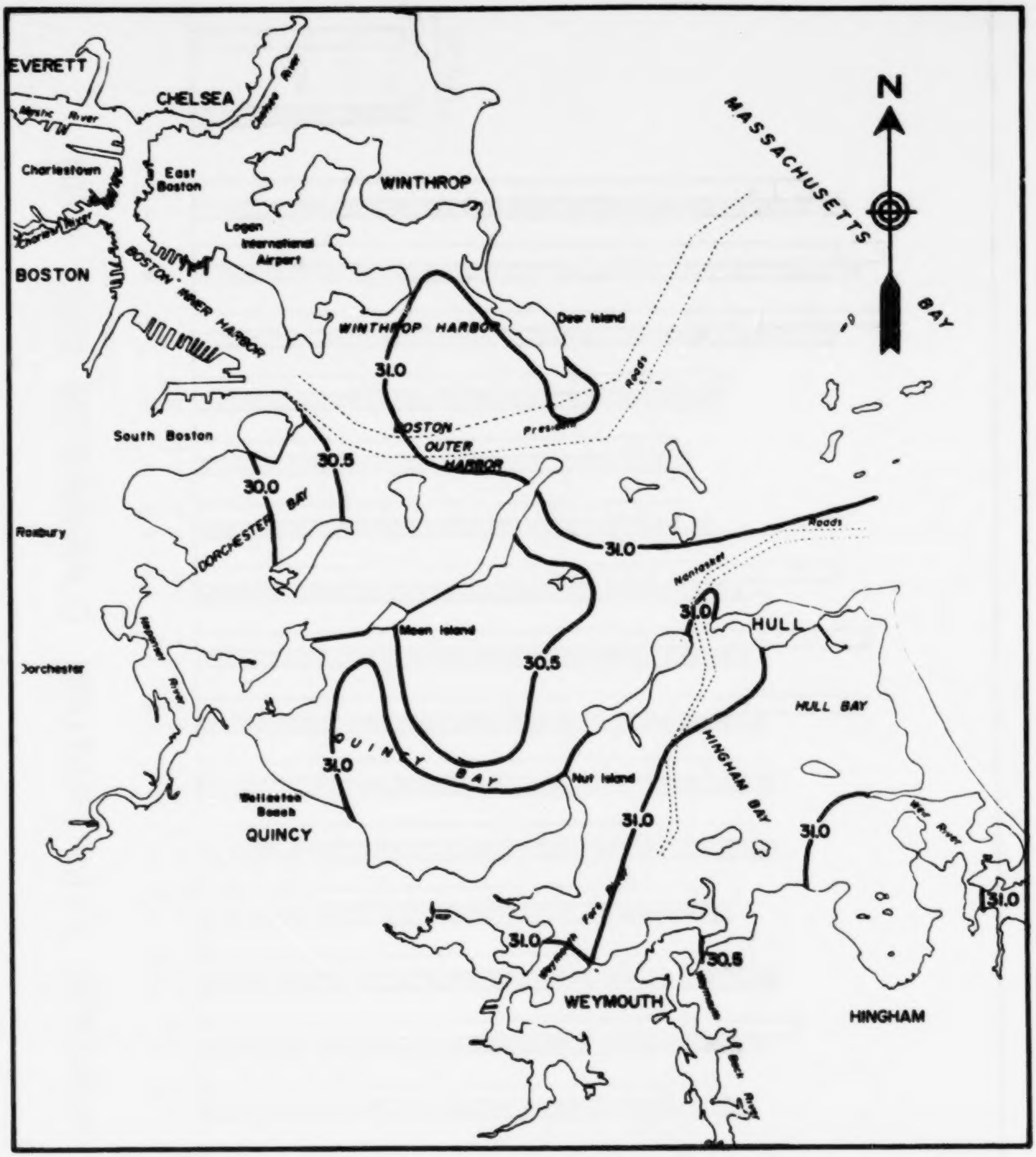
Tide	Time
Low	0000 hours
High	0624 hours
Low	1224 hours
High	1842 hours

The drogue traveled out the South Channel to Buoy C "7". Then it went east of rocks called Devil's Back. The drogue stalled northeast of Devil's Back. On the flood tide, the drogue started to return to the South Channel (see Figure 32).



SUMMER TEMPERATURE COMPARISON 1967-1968

FIGURE 26

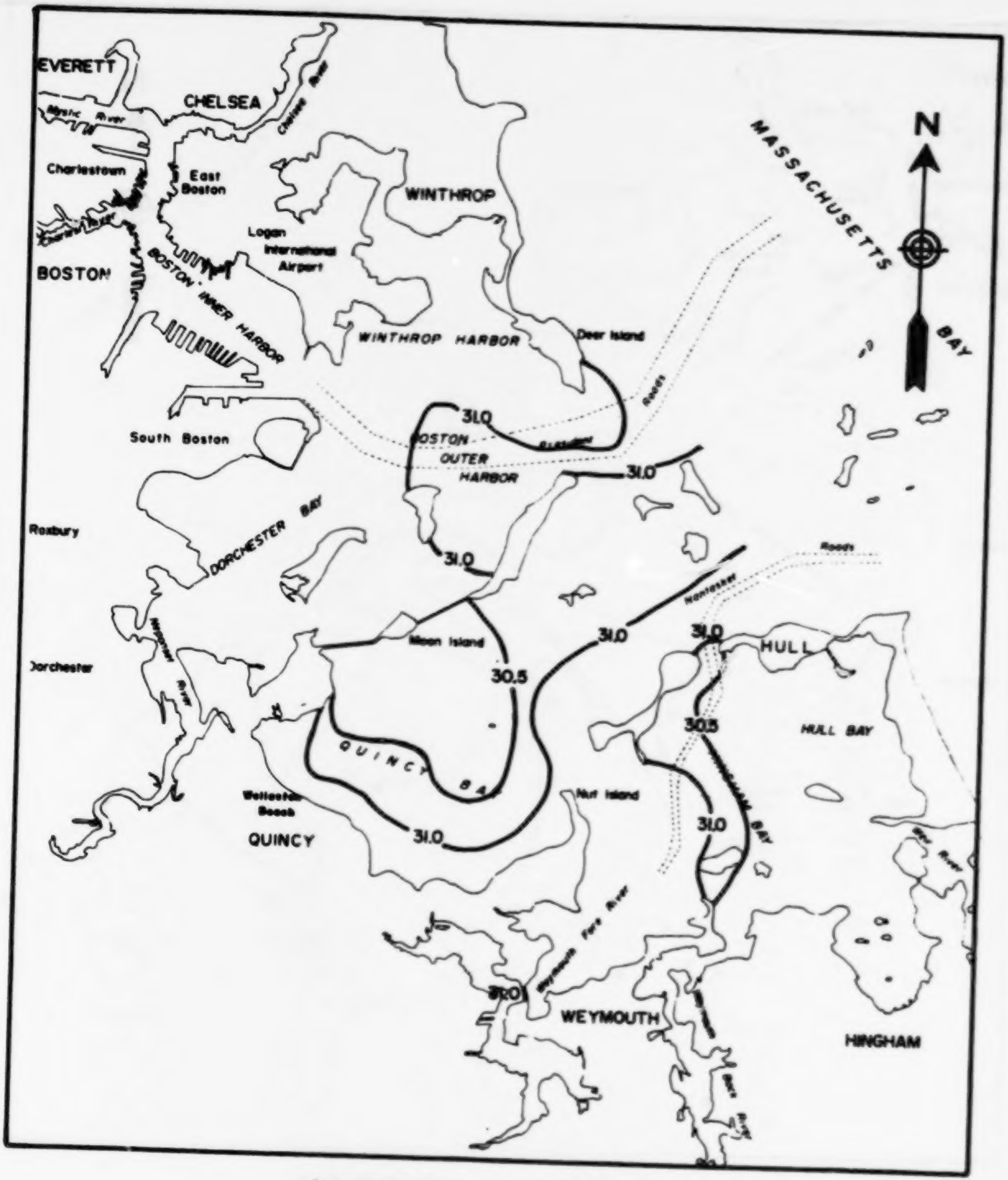

EVERETT
CHELSEA
Mystic River
Chelsea River
Charlestown
East Boston
WINTHROP
MASSACHUSETTS BAY
N
Logan International Airport
BOSTON
BOSTON INNER HARBOR
WINTHROP HARBOR
Deer Island
Roads
31.0
President
BOSTON OUTER HARBOR
South Boston
30.5
30.0
DORCHESTER BAY
Roxbury
31.0
Roads
Nantasket
31.0
HULL
Moon Island
30.5
Dorchester
Neponset River
HULL BAY
QUINCY BAY
31.0
Nut Island
HINGHAM BAY
Wollaston Beach
QUINCY
31.0
31.0
Weir River
31.0
Fore River
31.0
30.5
WEYMOUTH
HINGHAM
Back River

BOSTON HARBOR

SALINITY ‰
2.0 FOOT DEPTH
MEAN LOW TIDE

SUMMER 1968

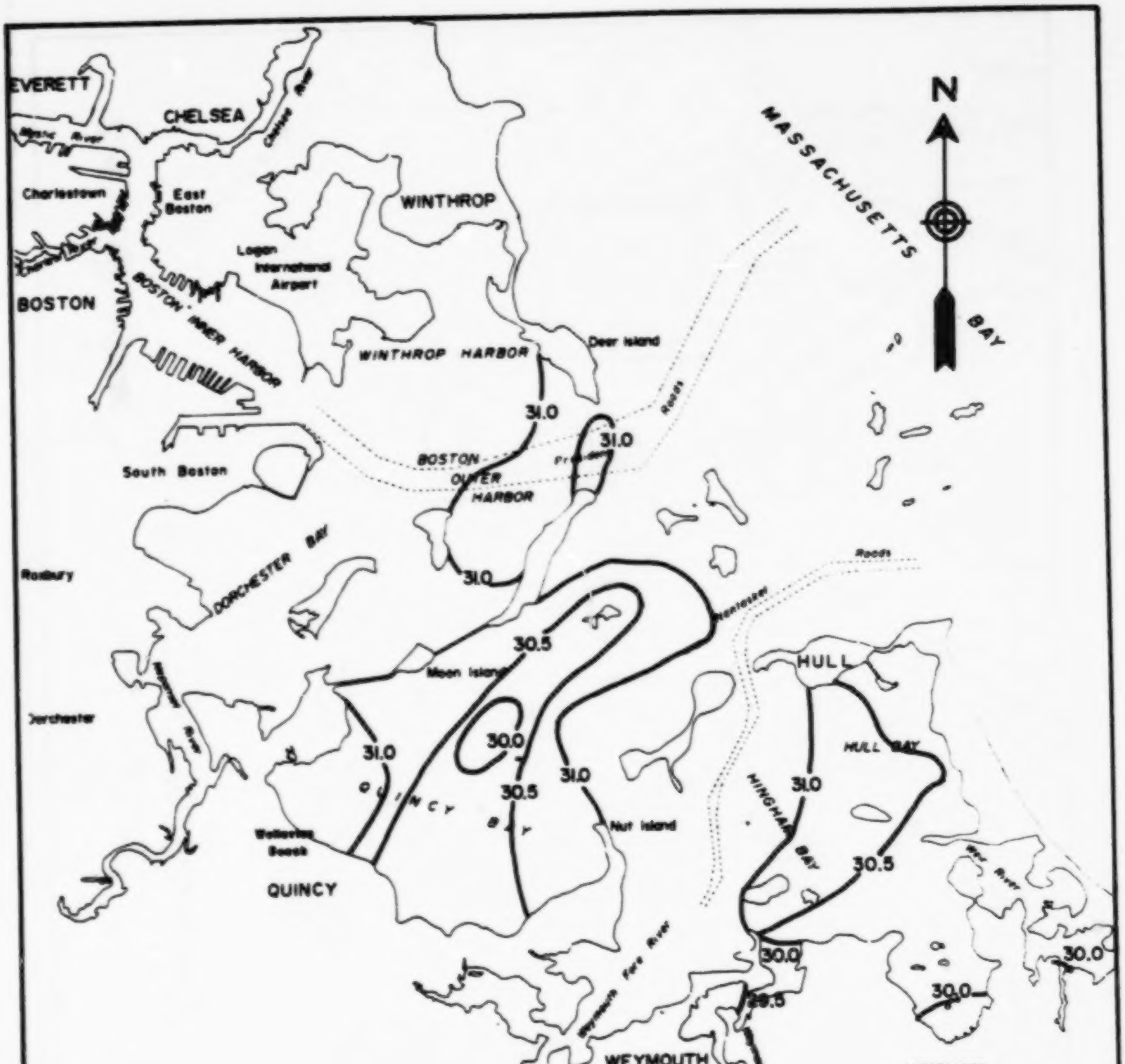
FIGURE 27


EVERETT
CHELSEA
Mystic River
Chelsea Creek
Charlestown
East Boston
Charles River
BOSTON
Logan International Airport
WINTHROP
BOSTON INNER HARBOR
WINTHROP HARBOR
Deer Island
MASSACHUSETTS BAY
N
South Boston
31.0
BOSTON OUTER HARBOR
Roads
Roxbury
DORCHESTER BAY
31.0
Nantasket
Roads
Moon Island
31.0
31.0
HULL
Dorchester
Neponset River
30.5
30.5
HULL BAY
QUINCY BAY
Wollaston Beach
Nut Island
31.0
QUINCY
31.0
Weir River
Weymouth Fore River
31.0
WEYMOUTH
Back River
HINGHAM

BOSTON HARBOR
SALINITY ‰
2.0 FOOT DEPTH
MEAN MID TIDE

SUMMER 1968

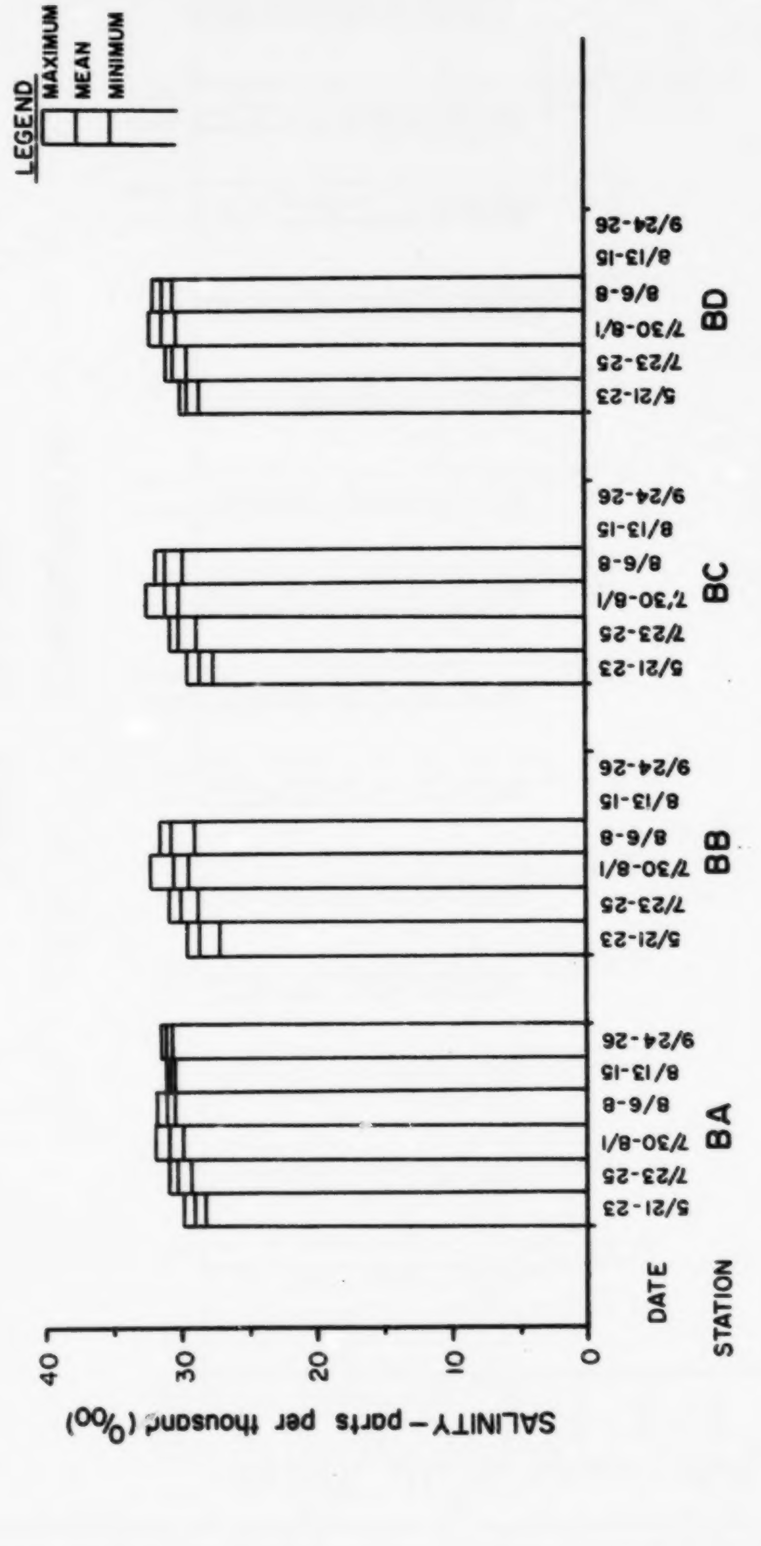
FIGURE 28


EVERETT
CHELSEA
Mystic River
Chelsea River
Charlestown
East Boston
Logan International Airport
WINTHROP
BOSTON
BOSTON INNER HARBOR
WINTHROP HARBOR
Deer Island
N
MASSACHUSETTS BAY
Roads
31.0
31.0
President
BOSTON OUTER HARBOR
South Boston
DORCHESTER BAY
Roxbury
31.0
Nantasket Roads
30.5
Moon Island
HULL
Dorchester
30.0
31.0
QUINCY BAY
30.5
31.0
HULL BAY
31.0
Nut Island
HINGHAM BAY
Wollaston Beach
30.5
QUINCY
30.0
30.0
30.0
29.5
Weymouth Fore River
WEYMOUTH
HINGHAM
Back River

BOSTON HARBOR
SALINITY ‰
2.0 FOOT DEPTH
MEAN HIGH TIDE

SUMMER 1968

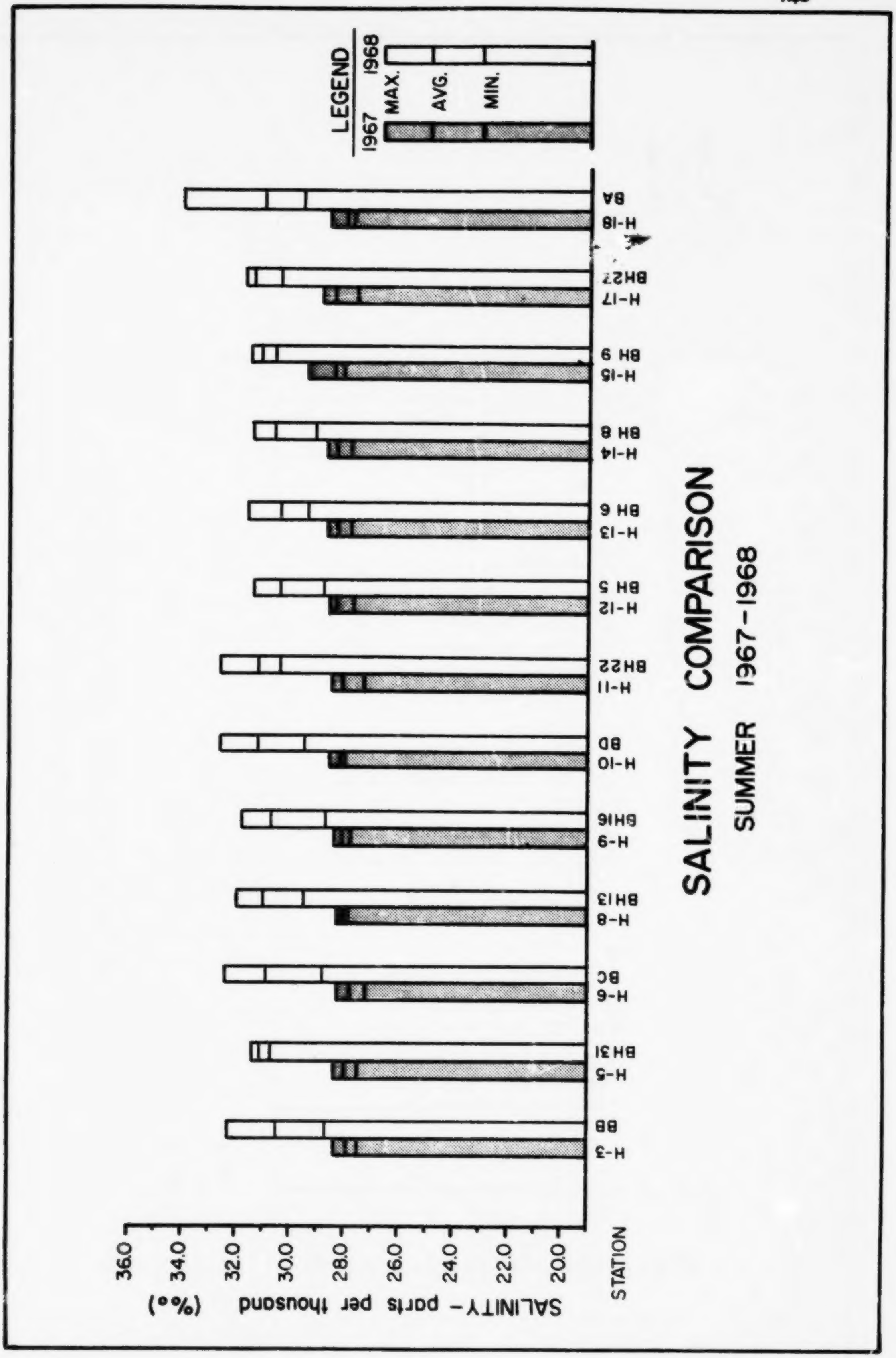
FIGURE 29



COMPARISON OF SALINITY

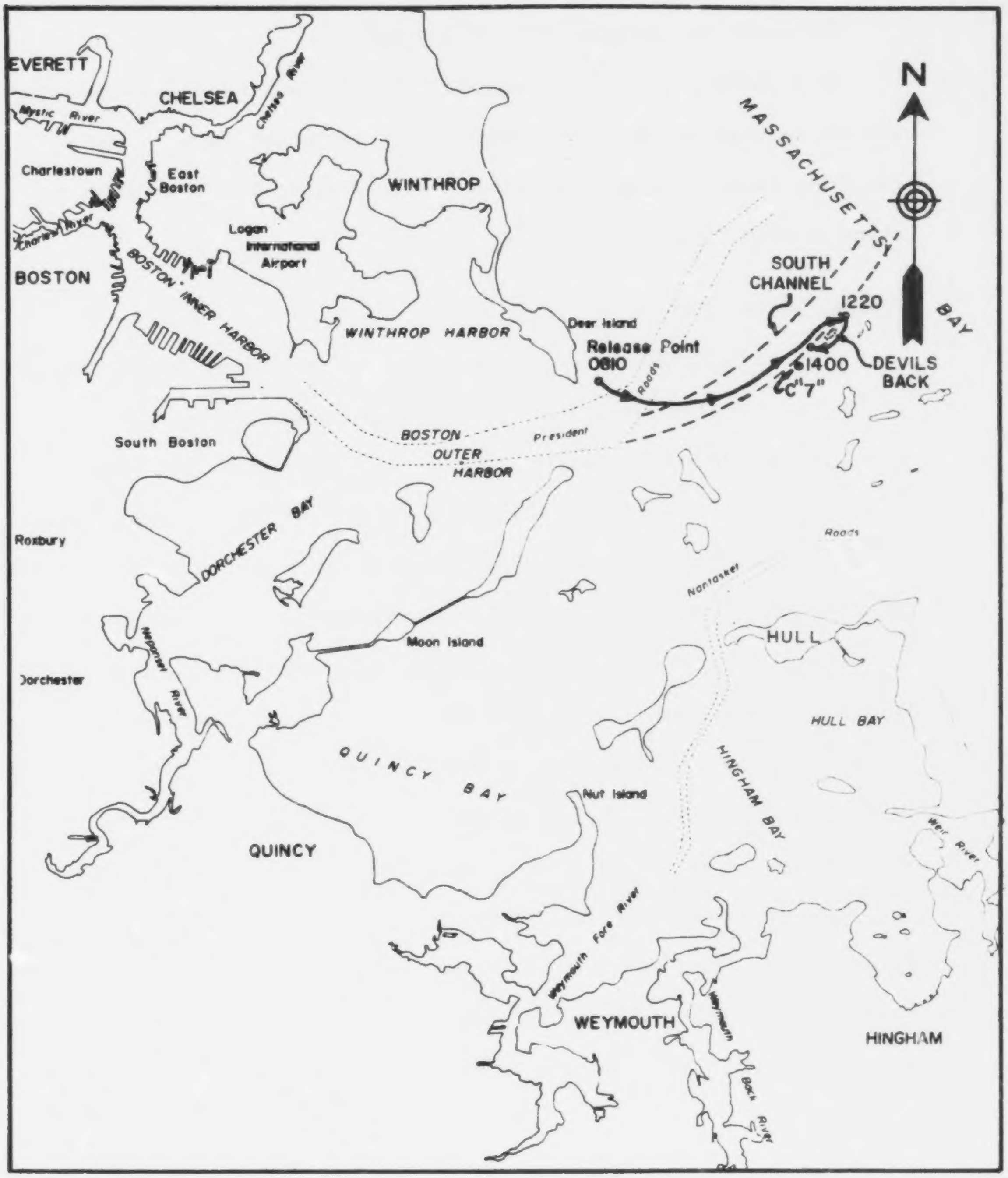
SUMMER – 1968

FIGURE 30


SALINITY COMPARISON

SUMMER 1967-1968

FIGURE 31


N
MASSACHUSETTS BAY
EVERETT
CHELSEA
Chelsea River
Mystic River
Charlestown
East Boston
Charles River
BOSTON
BOSTON INNER HARBOR
Logan International Airport
WINTHROP
WINTHROP HARBOR
Deer Island
Release Point 0810
Roads
SOUTH CHANNEL
1220
1400
DEVILS BACK
C"7"
BOSTON OUTER HARBOR
President
South Boston
Roxbury
DORCHESTER BAY
Moon Island
Dorchester
Neponset River
Nantasket
Roads
HULL
HULL BAY
QUINCY BAY
Nut Island
HINGHAM BAY
QUINCY
Weir River
Weymouth Fore River
WEYMOUTH
Weymouth Back River
HINGHAM

BOSTON HARBOR
DROGUE STUDY

OCTOBER 1968

FIGURE 32

The study was terminated at 1400 hours.

This pattern of movement suggests that the waters of Boston Harbor are not carried out into Massachusetts Bay any great distance and reaffirms other data in this report that indicates little transfer of water on each tidal cycle.

CURRENT METER STUDY

Five current meters were installed in Boston Harbor for the summer of 1967 to: (1) verify the U. S. Coast and Geodetic Survey current data, (2) develop more specific data on tidal currents at particular locations, and (3) determine the effect of wind on the currents. Figure 33 shows the location of the current meters. Only the meters at Stations BH-A and BH-D produced data, since the other meters were damaged.

The current at Station BH-A, located on President Roads between Long and Deer Islands, was recorded up to 1 1/2 knots (see Figure 34). The flow was in a general east-west direction (see Figure 35). The direction of the flow through the reach between Long and Rainsford Island (Station BH-D) was primarily in a north-south direction which is slightly different from the Coast and Geodetic's Tidal Current Charts.(5) More water appears to be moving through the channel in a southerly direction than in the northerly direction. As would be expected, current velocities are somewhat less than those recorded in the President's Roads area (Figure 37).

EVALUATION OF DEEP TUNNEL PROPOSAL

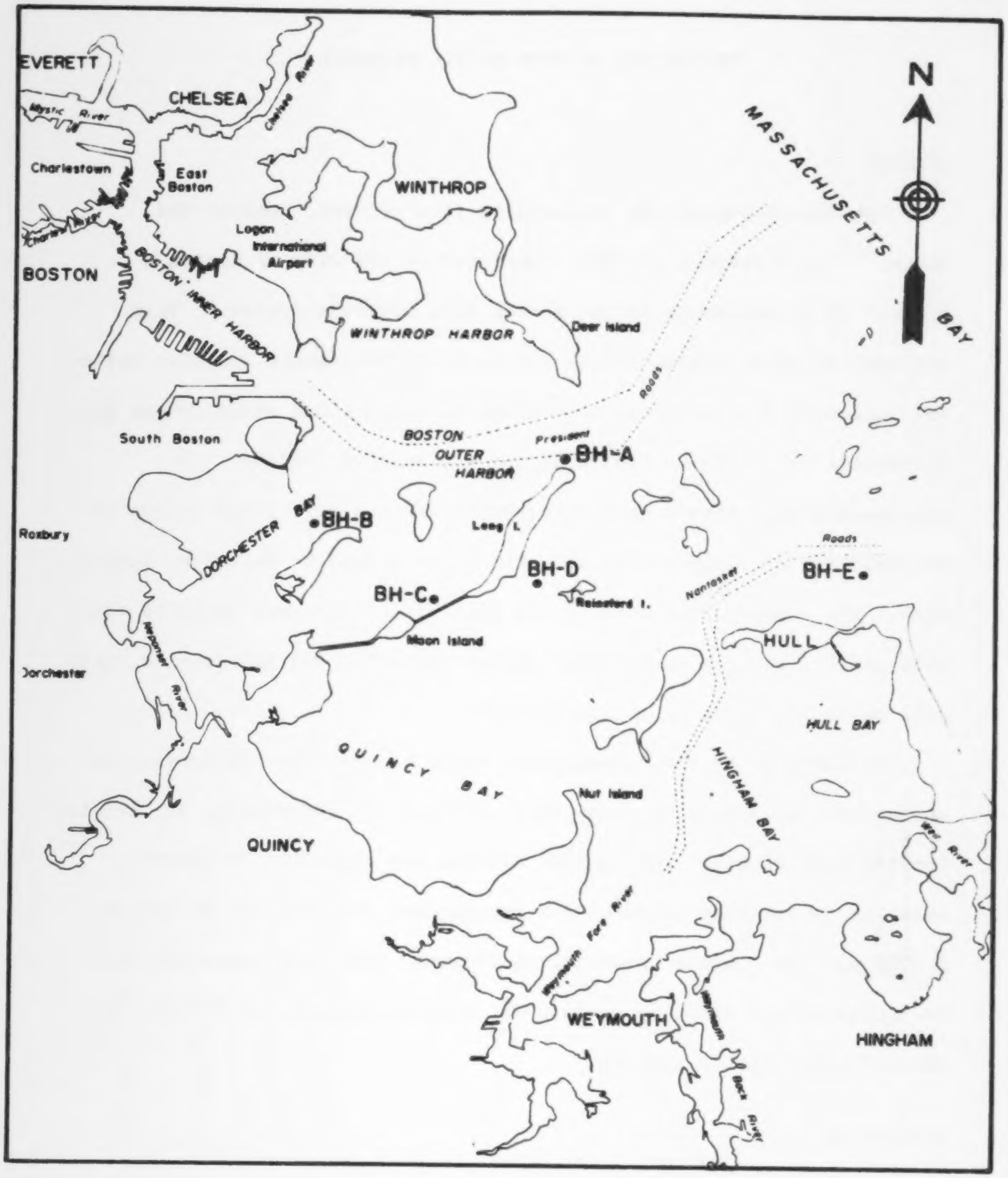
GENERAL

The Boston Consulting Engineering firm of Camp, Dresser and McKee,(2) in September of 1967, submitted to the city of Boston a "Report on Improvements to the Boston Main Drainage System." This engineering study evaluated the adequacy of the present drainage system and suggested four alternative methods of eliminating mixed sewage and stormwater overflows to Boston Harbor and adjacent waters. The recommended and least costly alternative for collecting and disposing of overflows of mixed sewage and stormwater proved to be a Deep Tunnel Plan. The construction cost of the Deep Tunnel proposal would be about $430 million and the capitalized annual operation and maintenance costs will be in the vicinity of $66 million.

In addition to the tunnel plan, which will effect the contiguous communities of Brookline, Cambridge, Chelsea and Somerville, an "Initial Construction Program" costing $38 million and requiring increased capacity in existing conduits was recommended for the city of Boston A $119 million "Future Construction Program" involving improvements to tidegates and existing outlets was also recommended to follow the initial construction program.

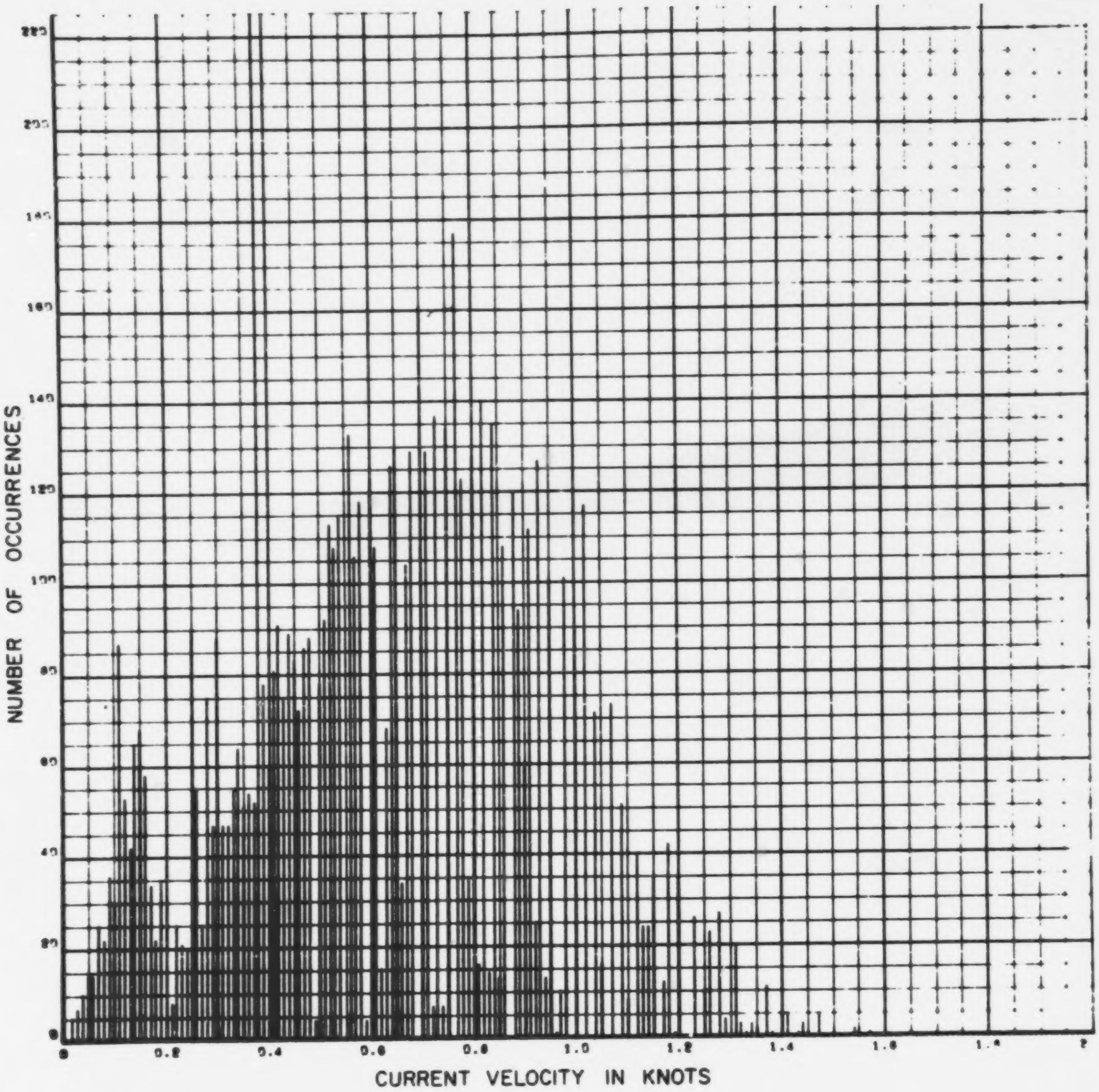
DISCUSSION

The Deep Tunnel Plan could provide a long-term solution to a significant problem of water quality in the Boston Harbor area.


EVERETT
CHELSEA
Mystic River
Chelsea River
Charlestown
East Boston
Charles River
BOSTON
Logan International Airport
WINTHROP
BOSTON INNER HARBOR
WINTHROP HARBOR
Deer Island
MASSACHUSETTS BAY
N
Roads
President
BOSTON OUTER HARBOR
BH-A
South Boston
BH-B
DORCHESTER BAY
Roxbury
Long I.
BH-D
BH-C
Rainsford I.
Nantasket Roads
BH-E
Moon Island
HULL
Dorchester
Neponset River
HULL BAY
QUINCY BAY
Nut Island
HINGHAM BAY
QUINCY
Weir River
Weymouth Fore River
WEYMOUTH
Weymouth Back River
HINGHAM

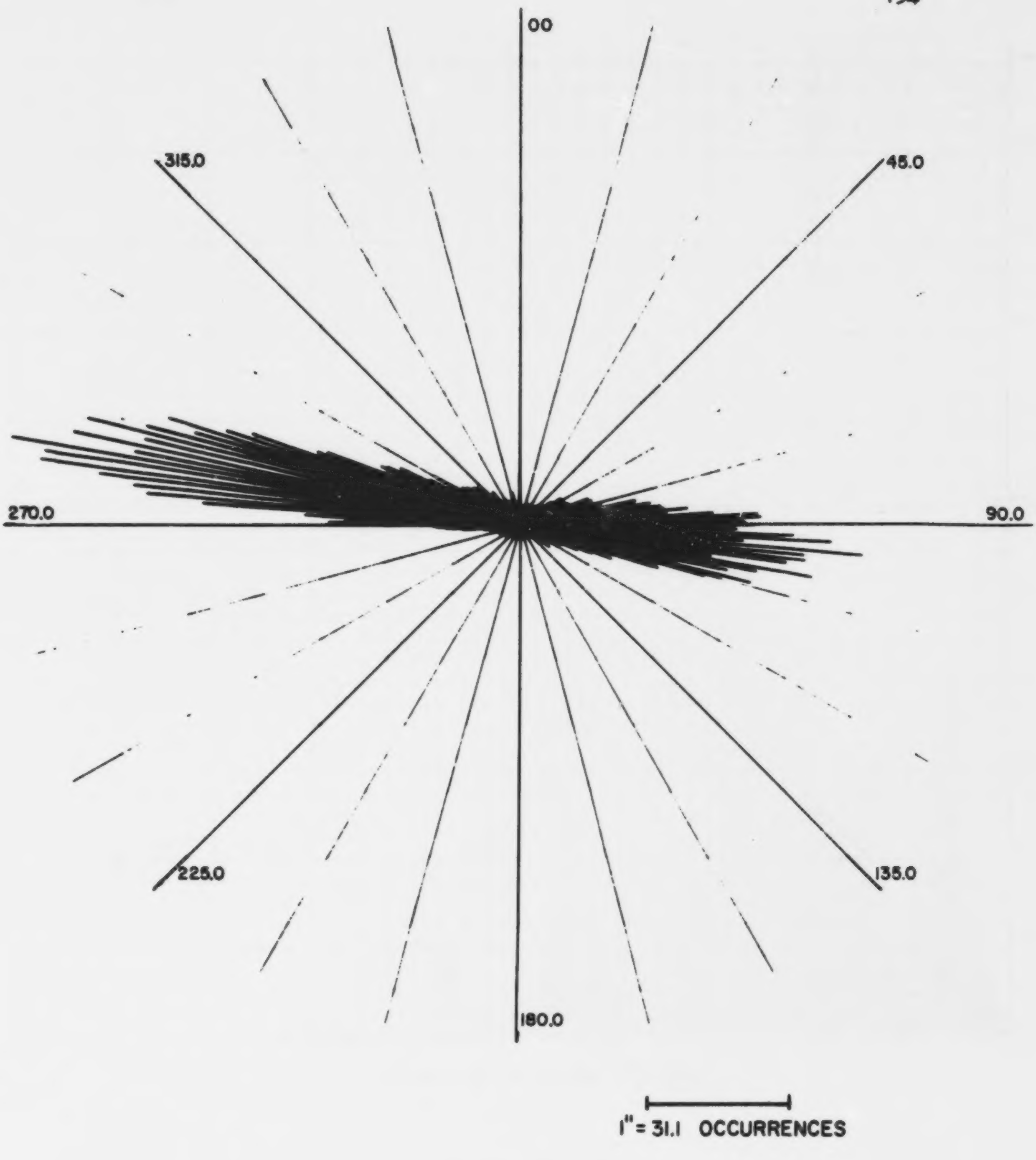
BOSTON HARBOR
LOCATION OF CURRENT METERS

FIGURE 33



STATION BH-A
CURRENT VELOCITY

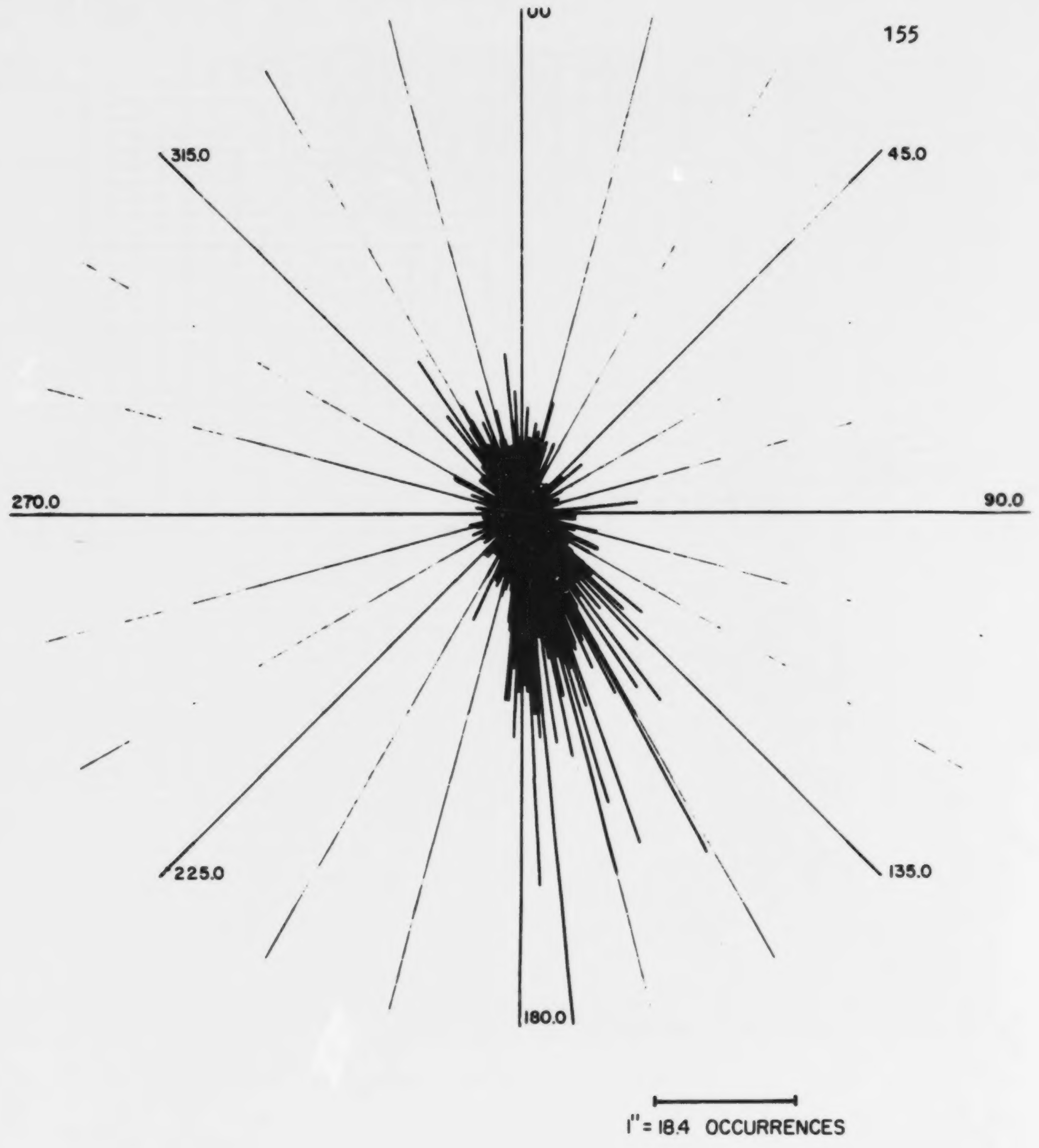
FIGURE 34



STATION BH-A

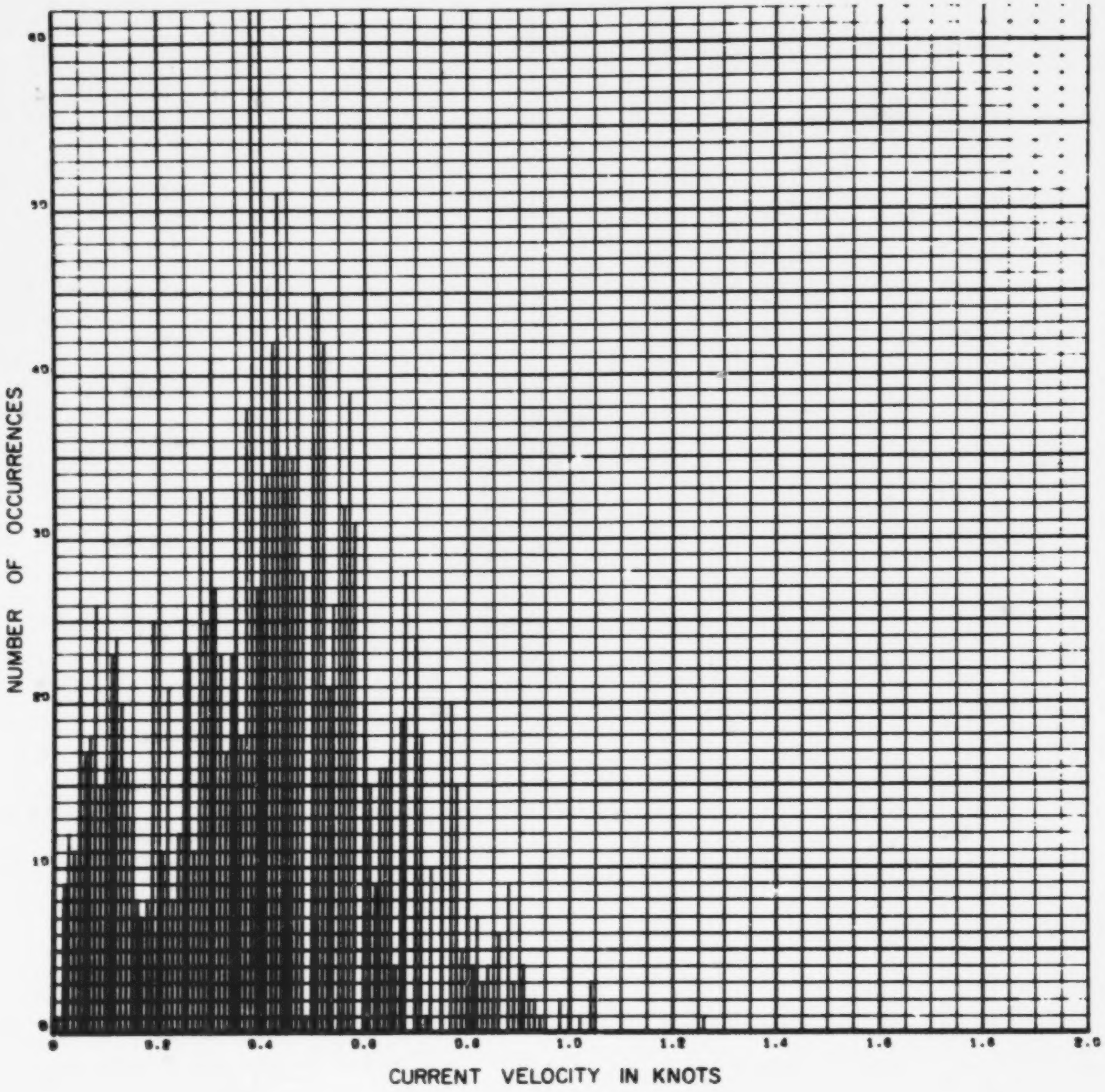
POLAR COORDINATE HISTOGRAM PLOT OF CURRENT DIRECTION

FIGURE 35



STATION BH-D
POLAR COORDINATE HISTOGRAM PLOT OF CURRENT DIRECTION

FIGURE 36



STATION BH-D
CURRENT VELOCITY

FIGURE 37

It is also a potential environmental project with major financial implications in a period where serious fiscal problems are being encountered by cities and towns, the State and Federal Government. It should be noted that under current Federal and State water pollution control laws, this project is not eligible for either State or Federal aid, and all costs must be born by affected communities and the M.D.C. Implementation of a vast program such as the Deep Tunnel Proposal would therefore appear to require further State and/or Federal enabling legislation. Should the plan prove to be the most feasible, the Commonwealth of Massachusetts would suggest that implementation of this vast program would appear to be best financed by a congressionally-authorized civil works project with the greatest percentage contributions coming from the Federal Government with cost sharing of the five communities, the M.D.C. and the Commonwealth.

Poor water quality in Boston Harbor results from numerous waste sources which have been described previously. These include municipal, industrial and watercraft sources, as well as mixed storm and sewage flows. The water quality data gathered to date indicates that complete elimination of all waste flows to the harbor is probably not feasible. The harbor waters are capable of assimilating some level, as yet undetermined, of waste discharge without falling below the required standards.

Due to the large financial costs involved, a satisfactory pollution abatement program should therefore consider the combined effect of specific treatment measures on each waste source, and should aim at providing the necessary total degree of treatment to achieve water quality standards in the harbor at least cost. This requires an examination of alternate treatment measures as well as the advantages of facilities which might serve more than one type of waste source.

It is therefore concluded the necessary legislation to fund and implement the Deep Tunnel Proposal will not be enacted until further study of a comprehensive nature is completed and approved by the appropriate legislative bodies.

The Initial Construction Program and the Future Construction Program should proceed nevertheless in preparation for future projects in the Boston Harbor area. These programs suggest that sanitary sewers and storm conduits should be constructed wherever existing principal conduits do not provide adequate capacity to carry estimated year 2020 peak design flows or runoff from 15-year frequency design rainstorms. Recommended improvements have been arranged in two programs; the Initial Construction Program and the Future Construction Program because of structural conditions evidenced by failures which have occurred in existing sewers, and in addition, the facilities which are affected by the initial program are the most important parts of the existing system located in the core area of the city and along the most heavily utilized beach areas in the city. Three stages of construction are proposed for the Initial Construction Program with a total estimated construction cost of $38 million. Improvements to existing outlets (including tide gates) and appurtenant facilities not included in the initial program are recommended in the Future Construction Program which is estimated to cost $119 million. Such improvements will serve to reduce the volume of tide water entering the sewerage system, reduce the degree of surcharging in existing sewers, and in addition, reduce the volume of tide water reaching the MDC facilities. Proposed facilities included in the Initial and Future Construction Programs are designed to complement the proposed Deep Tunnel Plan. They are, however, necessary with or without the Deep Tunnel.

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APPENDICES

APPENDIX A

APPENDIX A

BOSTON HARBOR STUDY - 1968

STATION LOCATION

1967 STATION (if any)	1968 STATION	LATITUDE ° ' "	LONGITUDE ° ' "	DESCRIPTION
H-18	BA	42 21 00	70 58 45	Deer Island flats near Buoy "C-3"
H-3	BB	42 19 00	71 01 20	Dorchester Bay between Buoys "3" and "N-4"
H-6	BC	42 18 40	70 59 25	Approximately 100 yards off Moon Island on line with Spectacle Island.
H-10	BD	42 16 60	70 57 00	Off Nut Island in West Gut near Buoy "5"
W-1	BH-1	42 15 45	70 52 05	Weir River near Planters Hill
	BH-2	42 16 30	70 52 45	Weir River near Buoy "N-2"
	BH-3	42 15 35	70 53 05	Hingham Harbor near Buoy "N-12"
	BH-4	42 14 55	70 52 55	Hingham Harbor near Buoy "N-22"
	BH-5	42 16 25	70 54 00	Crow Point Flats near Buoy "N-6"
H-13	BH-6	42 17 25	70 53 25	Hull Bay near Buoy "R-2"
	BH-7	42 17 55	70 54 00	Hull Bay 50 yards west of Hog Island
H-14	BH-8	42 17 40	70 55 30	Hingham Bay near Buoy "5"
	BH-9	42 18 40	70 55 20	Nantasket Roads near Buoy "11"
	BH-10	42 19 05	70 52 50	Nantasket Roads near Buoy "3"
	BH-11	42 15 40	70 55 15	Weymouth Back River near Buoy "C-7"
WB-1	BH-12	42 15 10	70 55 55	Weymouth Back River near Buoy "C-15"
H-8	BH-13	42 17 15	71 00 10	Quincy Bay near Buoy "C-1"
	BH-14	42 16 55	71 00 35	Quincy Bay near Buoy "C-3"
	BH-15	42 16 30	70 59 45	Quincy Bay approximately 200 yards off Wollaston Beach near Black Creek.
H-9	BH-16	42 16 30	70 58 20	Quincy Bay approximately 500 yards off shore near Seal Rock.
	BH-17	42 17 15	70 58 40	Quincy Bay off Hangman Island at Marker "3"
	BH-18	42 17 35	70 57 25	Between Peddocks Island and Sunken Ledge near flashing Buoy "2".
H-7	BH-19	42 18 20	70 57 40	Off Rainsford Island near Buoy "C-7"
	BH-20	42 18 40	70 56 30	Nantasket Roads near Buoy "C-A-Ex"
	BH-21	42 16 50	70 55 55	Weymouth Fore River off Sheeps Island near Buoy RB-N
H-11	BH-22	42 15 45	70 56 15	Weymouth Fore River near Buoy "C-19"
	BH-23	42 15 05	70 57 15	Weymouth Fore River near Buoy "N-28"
WF-1	BH-24	42 14 20	70 58 10	Weymouth Fore River 100 yards off dry docks.

APPENDIX A

(Continued)

1967 STATION (if any)	1968 STATION	LATITUDE			LONGITUDE			DESCRIPTION
		°	'	"	°	'	"	
	BH-25	42	15	15	70	58	40	Town River in Hole Point Reach at Buoy "C-9"
	BH-26	42	20	25	70	57	20	At Deer Island sewage treatment plant discharge on west side of lighthouse.
H-17	BH-27	42	20	35	70	56	35	Boston North Channel near Buoy R-10
	BH-28	42	20	20	70	55	55	Boston South Channel near Buoy "C-13"
	BH-29	42	20	00	70	56	15	The Narrows near Buoy "N-6"
	BH-30	42	19	50	70	57	05	Nubble Channel near Buoy "C-5"
	BH-31	42	19	55	70	57	35	President Roads near Buoy "C-13"
	BH-32	42	20	10	70	57	50	President Roads between Deer and Spectacle Islands.
	BH-33	42	20	25	70	58	00	President Roads between Long Island and Deer Island flats.
	BH-34	42	20	40	70	57	35	West of Deer Island near Buoy "W-A" gong.
	BH-35	42	20	35	70	59	00	Governor's Island flats near Buoy "C-1"
	BH-36	42	19	50	70	58	45	President Roads near Spectacle Island near Buoy "C-1"
H-5	BH-37	42	19	35	70	58	05	Approximately 50 yards of dock on northwest side of Long Island.
H-1	BH-38	42	22	00	71	02	50	Boston Inner Harbor near mouth of Charles River.
H-2	BH-39	42	20	05	70	59	30	President Roads near Spectacle Island
H-4	BH-40	42	18	30	71	02	00	Dorchester Bay at mouth of Neponset River.
H-16	BH-41	42	19	05	70	56	55	Between Long Island and Gallops Island
H-16A	BH-42	42	19	20	70	56	10	Between Gallops Island and Georges Island
H-19	BH-43	42	22	15	70	59	55	Winthrop Bay near Chelsea Point
H-20	BH-44	42	22	50	71	00	15	Winthrop Bay near Orient Heights
H-21	BH-45	42	21	05	70	53	30	100 yards east of Green Island
H-12	BH-46	42	16	45	70	55	05	East of Sheeps Island near Buoy "C-13"
H-15	BH-47	42	18	15	70	55	35	Nantasket Gut near Buoy "R-12"

APPENDIX B

TABLE B-1

SUMMARY OF FIELD DATA - STATION 6A

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER I 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4. MG/L	COLIFORM BACTERIA MF TOTAL	COLIFORM BACTERIA MF FECAL
5-21-68	830	11.0	2.0	7.3					
5-21-68	840	11.0	20.0	8.1					
5-21-68	1030	11.0	2.0	6.8				360	32
5-21-68	1030	11.0	20.0	8.2				550	30
5-21-68	1320	12.5	2.0	6.8	29.2			10-	2-
5-21-68	1320	12.7	5.5	6.6	29.0			150	4
5-21-68	1605	12.1	15.0		29.4			510	18
5-21-68	1605	12.5	2.0		29.1			60	2
5-21-68	1750	11.2	10.0	7.5	29.0			3900	158
5-21-68	1750	12.2	2.0	7.0	28.5			400	12
5-22-68	750	10.9	10.0	7.8	29.6			2300	52
5-22-68	750	11.3	2.0	8.0	29.3			790	26
5-22-68	950	12.0	2.0	6.7	28.7			810	12
5-22-68	950	11.1	20.0	7.5	29.2			1600	34
5-22-68	1255	12.9	2.0	6.5	28.9			14000	2
5-22-68	1255	12.3	10.0	6.2	28.9			760	26
5-22-68	1500	13.1	2.0	6.5	29.3			40	2-
5-22-68	1500	12.7	10.0	6.1	29.1			490	2
5-22-68	1830	12.9	2.0	6.5	28.6			460	14

TABLE B-1 (CONT.)

SUMMARY OF FIELD DATA - STATION 6A

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER I 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4, MG/L	COLIFORM BACTERIA MF TOTAL	COLIFORM BACTERIA MF FECAL
5-22-68	1830	11.4	10.0		29.6				
5-23-68	745	11.7	2.0	6.5	29.3			27500	520
5-23-68	745	11.4	14.0	6.6	29.7			5300	106
5-23-68	1000	12.8	2.0	6.6	28.7			3400	26
5-23-68	1000	11.7	16.0	6.4	29.3			7100	230
5-23-68	1230	13.1	2.0	5.8	28.8			640	12
5-23-68	1230	12.6	14.0	6.0	29.1			660	24
5-23-68	1455	13.5	2.0	6.3	28.9			110	4
5-23-68	1455	12.6	12.0	5.9	29.0			520	18
5-23-68	1720	12.9	12.0	6.5	29.0			270	2
5-23-68	1720	14.1	2.0	6.8	28.3			520	24

TABLE B-2

SUMMARY OF FIELD DATA - STATION BB

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER I 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4. MG/L	COLIFORM BACTERIA MF TOTAL	COLIFORM BACTERIA MF FECAL
5-21-68	800	10.5	2.0	7.2					
5-21-68	800	10.5	18.0	7.4					
5-21-68	1015	11.5	2.0	6.8				520	30
5-21-68	1015	11.5	25.0	7.3				10-	2
5-21-68	1310	12.5	2.0	6.8	27.5			240	22
5-21-68	1310	11.6	20.0	6.2	28.7			310	14
5-21-68	1350	11.5	20.0	6.2	28.7			180	16
5-21-68	1350	13.3	2.0	6.8	27.1			20	2-
5-21-68	1704	11.4	25.0	7.3	29.5			690	36
5-21-68	1704	12.8	2.0	7.2	27.9			470	18
5-22-68	740	11.0	25.0	7.4	29.6			1200	44
5-22-68	740	11.8	2.0	6.7	28.6			1000	48
5-22-68	940	12.2	2.0	7.4	28.7			550	24
5-22-68	940	11.3	20.0	7.5	29.2			470	14
5-22-68	1240	13.1	2.0	6.8	27.9			190	10
5-22-68	1240	11.2	15.0	6.6	28.9			700	30
5-22-68	1445	13.5	2.0	6.8	27.5			70	12
5-22-68	1445	12.0	25.0	6.2	28.9			490	2
5-22-68	1815	12.8	2.0	6.2	28.6			220	20

TABLE B-2 (CONT.)

SUMMARY OF FIELD DATA - STATION BB

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER I 1968

DATE	TIME	TEMP.	DEPTH	D.O.	SALINITY	NO3-N	TOTAL ORTHO-PHOSPHATE	COLIFORM BACTERIA MF	
		DEG.C	FT.	MG/L	PPT	MG/L	PO4, MG/L	TOTAL	FECAL
5-22-68	1815	11.3	15.0	6.9	29.6			710	18
5-23-68	725	12.3	2.0	6.9	28.6			2000	68
5-23-68	725	11.7	23.0	6.0	29.6			810	64
5-23-68	945	12.6	2.0		28.8			2700	46
5-23-68	945	11.4	32.0	7.6	29.5			920	30
5-23-68	1215	13.8	2.0	6.3	27.9			190	2-
5-23-68	1215	11.6	32.0	6.7	29.3			870	38
5-23-68	1440	14.4	2.0	6.1	27.2			290	12
5-23-68	1440	11.8	14.0	6.3	28.7			270	10
5-23-68	1710	13.9	2.0	6.4	28.3			40	2-
5-23-68	1710	12.4	28.0	6.1	29.0			19190	21

TABLE B-3

SUMMARY OF FIELD DATA - STATION BC

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER I 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4, MG/L	COLIFORM BACTERIA MF TOTAL	FECAL
5-21-68	840	10.5	2.0	7.0					
5-21-68	850	-0.0	15.0	7.1					
5-21-68	1045	11.0	2.0	6.3				730	68
5-21-68	1045	11.0	15.0	6.8				270	26
5-21-68	1345	12.4	2.0	6.8	27.8			800	146
5-21-68	1345	12.3	7.0	6.6	28.0			2700	200
5-21-68	1615	13.5	2.0	6.2	27.6			600	8
5-21-68	1615	12.2	7.0	6.7	27.7			1700	102
5-21-68	1800	11.5	10.0	7.8	28.9			4300	86
5-21-68	1800	12.7	2.0	7.0	28.0			2300	78
5-22-68	805	11.3	10.0	7.0	29.5			2700	90
5-22-68	805	11.7	2.0	7.4	28.8			400	16
5-22-68	1020	12.5	2.0	7.0	28.4			280	18
5-22-68	1020	11.6	10.0	6.9	29.1			500	24
5-22-68	1305	12.9	2.0	6.8	28.1			620	44
5-22-68	1305	12.9	7.0	6.5	28.1			470	20
5-22-68	1700	12.4	2.0	6.7	28.8			380	30
5-22-68	1700	11.7	10.0	6.6	29.1			510	12
5-22-68	1850	12.0	2.0	6.8	28.8			15000	54

TABLE B-3 (CONT.)

SUMMARY OF FIELD DATA - STATION BC

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER I 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4, MG/L	COLIFORM BACTERIA MF	
								TOTAL	FECAL
5-22-68	1850	11.6	7.0	6.9	29.2			500	18
5-23-68	800	12.3	2.0	6.1	28.9			6000	130
5-23-68	800	12.8	12.0	6.2	29.3			4900	186
5-23-68	1020	12.5	2.0	6.2	29.6			340	30
5-23-68	1020	12.8	12.0	6.4	29.2			4800	144
5-23-68	1240	14.7	2.0	6.6	27.6			1400	58
5-23-68	1240	12.7	6.0	6.3	28.8			530	34
5-23-68	1540	14.0	2.0	4.1	28.9			250	10
5-23-68	1540	14.0	6.0	6.7	28.9			2300	96
5-23-68	1735	13.7	2.0	6.2	28.8			410	10
5-23-68	1735	13.6	8.0	8.0	29.0			410	28

TABLE B-4

SUMMARY OF FIELD DATA - STATION 6D

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER I 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4, MG/L	COLIFORM BACTERIA MF TOTAL	COLIFORM BACTERIA MF FECAL
5-21-68	900	-0.0	2.0	8.0					
5-21-68	900	-0.0	25.0	8.5					
5-21-68	1115	10.5	2.0	8.5				10	10
5-21-68	1115	10.5	25.0	8.2				180	26
5-21-68	1350	11.9	2.0	8.1	29.0			70	4
5-21-68	1350	11.4	25.0	8.3	29.5			20	2-
5-21-68	1630	11.3	25.0	7.0	29.4			70	10
5-21-68	1630	12.9	2.0	7.0	28.5			210	12
5-21-68	1815	10.8	19.0	8.3	29.5			150	10
5-21-68	1815	11.1	2.0	8.5	29.5			40	4
5-22-68	815	10.7	28.0	8.4	29.8			60	4
5-22-68	815	10.8	2.0	8.6	29.7			120	2
5-22-68	1040	12.0	2.0	8.2	29.3			3600	26
5-22-68	1040	10.8	25.0	9.2	29.7			70	6
5-22-68	1320	12.8	2.0	8.3	29.3			10	2
5-22-68	1320	11.7	20.0	8.2	29.4			110	10
5-22-68	1715	12.2	2.0		29.5			570	6
5-22-68	1715	11.8	25.0	7.9	29.8			50	10
5-22-68	1855	11.8	2.0	7.9	29.5			30	8

TABLE B-4 (CONT.)

SUMMARY OF FIELD DATA - STATION BD

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER I 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4. MG/L	COLIFORM BACTERIA MF TOTAL	COLIFORM BACTERIA MF FECAL
5-22-68	1855	11.1	25.0	8.2	29.9			40	4
5-23-68	810	11.5	2.0	7.9	29.6			60	2
5-23-68	810	11.3	34.0	8.3	29.9			30	6
5-23-68	1045	13.9	2.0	7.3	29.3			70	2-
5-23-68	1045	11.7	32.0	8.2	28.8			30	2
5-23-68	1255	13.6	2.0	7.9	29.2			30	2-
5-23-68	1255	12.0	30.0	8.2	29.5			100	4
5-23-68	1550	13.0	2.0		29.3			10-	2-
5-23-68	1550	12.5	26.0	6.1	29.3			40	2-
5-23-68	1745	12.6	2.0	8.2	26.6			20	2-
5-23-68	1745	12.2	24.0	8.4	29.5			20	2

TABLE B-5

SUMMARY OF FIELD DATA - STATION BA

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER II 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO_3-N MG/L	TOTAL ORTHO-PHOSPHATE PO_4, MG/L	COLIFORM BACTERIA MF TOTAL	FECAL
7-23-68	1045	17.7	2.0		29.2			300	32
7-23-68	1310	18.7	2.0		29.6			100	10
7-23-68	1530	19.6	2.0		29.3			90	4
7-24-68	1124	16.5	2.0	7.8	30.4			21000	14000
7-24-68	1357	17.6	2.0		30.5	.03		190	16
7-24-68	1600	18.1	2.0		31.0		.21	110	2
7-25-68	1130	16.0	2.0	8.2	30.5			2100	170
7-25-68	1405	16.0	2.0		30.6			2400	240
7-25-68	1620	16.8	2.0	8.5	30.7			500	80

TABLE B-6

SUMMARY OF FIELD DATA - STATION BB

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER II 1968

DATE	TIME	TEMP.	DEPTH	D.O.	SALINITY	NO3-N	TOTAL ORTHO-PHOSPHATE	COLIFORM BACTERIA MF	
		DEG.C	FT.	MG/L	PPT	MG/L	PO4. MG/L	TOTAL	FECAL
7-23-68	1135	18.3	2.0		29.6			300	6
7-23-68	1323	19.9	2.0		28.7			10	2-
7-23-68	1545	19.3	2.0		29.3			10-	2-
7-24-68	1110	18.9	2.0	7.9	30.1			6600	50
7-24-68	1345	19.4	2.0		30.3	.05		10	2
7-24-68	1545	18.2	2.0		30.9		.25	2700	44
7-25-68	1115	17.3	2.0	8.0	30.6			730	100
7-25-68	1350	18.0	2.0		30.5			190	22
7-25-68	1605	18.2	2.0	8.6	30.3			150	14

TABLE B-7

SUMMARY OF FIELD DATA - STATION BC

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER II 1968

DATE	TIME	TEMP.	DEPTH	D.O.	SALINITY	NO3-N	TOTAL ORTHO-PHCSPHATE	COLIFORM BACTERIA MF	
		DEG.C	FT.	MG/L	PPT	MG/L	PO4. MG/L	TOTAL	FECAL
7-23-68	1100	19.2	2.0		29.5			1100	200
7-23-68	1300	19.8	2.0		29.4			10	4
7-23-68	1500	20.7	2.0		28.8			10-	2
7-24-68	1135	17.7	2.0	8.0	30.5			5200	58
7-24-68	1407	19.4	2.0		30.4	.04		11000	1100
7-24-68	1610	18.9	2.0		30.4				
7-25-68	1140	18.4	2.0	7.3	30.7			3000	300
7-25-68	1420	19.2	2.0		30.5			500	10-
7-25-68	1630	19.0	2.0	9.5	30.4			100	50

TABLE B-8

SUMMARY OF FIELD DATA - STATION 6D

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER II 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4, MG/L	COLIFORM BACTERIA MF TOTAL	 FFCAL
7-23-68	1115	17.0	2.0		29.8			17000	30
7-23-68	1240	19.2	2.0		29.9			130	28
7-23-68	1513	18.8	2.0		29.5			100	10
7-24-68	1147	16.9	2.0	7.9	30.7			7400	6
7-24-68	1419	17.5	2.0		31.2	.04		60	
7-24-68	1615	17.8	2.0		31.2			70	2
7-25-68	1155	16.3	2.0	8.3	30.8		.24	30	4
7-25-68	1510	17.3	2.0		30.8			40	2-
7-25-68	1640	17.4	2.0	8.3	30.8			130	4

TABLE B-9

SUMMARY OF FIELD DATA - STATION BH-1

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER II 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4, MG/L	COLIFORM BACTERIA MF TOTAL	COLIFORM BACTERIA MF FECAL
7-23-68	1155	21.0	2.0		31.1			10	10
7-23-68	1350	22.3	2.0		31.0			90	8
7-23-68	1610	24.3	2.0		30.9			130	12
7-24-68	1615	21.8	2.0		30.2		.39	170	14
7-24-68	1215	20.2	2.0	7.3	30.4			5500	24
7-24-68	1340	21.1	2.0		30.3	.05		80	4
7-25-68	1230	19.7	2.0	6.9	29.5			60	6
7-25-68	1430	20.7	2.0		29.6			170	2-
7-25-68	1625	22.0	2.0	7.5	29.4			160	6

TABLE B-10

SUMMARY OF FIELD DATA - STATION BH-2

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER II 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4, MG/L	COLIFORM BACTERIA MF TOTAL	COLIFORM BACTERIA MF FECAL
7-23-68	1138	19.4	2.0		31.3			60	2
7-23-68	1345	22.0	2.0		31.2			40	6
7-23-68	1605	22.9	2.0		31.3			60	8
7-24-68	1620	20.7	2.0		30.7		.29	80	12
7-24-68	1205	19.7	2.0	2.3	30.2			6000	6
7-24-68	1345	20.5	2.0		30.3	.04		2400	200
7-25-68	1235	19.6	2.0	2.9	29.2			10	2
7-25-68	1435	20.4	2.0		29.5			540	36
7-25-68	1635	20.8	2.0	7.6	29.7			10-	4

TABLE B-11

SUMMARY OF FIELD DATA - STATION BH-3

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER II 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4. MG/L	COLIFORM BACTERIA MF TOTAL	COLIFORM BACTERIA MF FECAL
7-23-68	1144	21.2	2.0		31.2			100	12
7-23-68	1405	22.9	2.0		31.2			20	2-
7-23-68	1620	22.5	2.0		31.4			10	2-
7-24-68	1155	20.6	2.0	7.2	30.3			5600	4
7-24-68	1330	21.4	2.0		30.5	.06		80	2-
7-24-68	1600	21.3	2.0		30.6		.26	10-	4
7-25-68	1216	20.2	2.0	7.0	30.2			10	2-
7-25-68	1420	20.5	2.0		29.6			10-	2-
7-25-68	1610	21.1	2.0	9.0	29.8			10-	2

TABLE B-12

SUMMARY OF FIELD DATA - STATION BH-4

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER II 1968

DATE	TIME	TEMP.	DEPTH	D.O.	SALINITY	NO3-N	TOTAL ORTHO-PHOSPHATE	COLIFORM BACTERIA MF	
		DEG.C	FT.	MG/L	PPT	MG/L	PO4, MG/L	TOTAL	FECAL
7-23-68	1200	21.2	2.0		31.1			200	2-
7-23-68	1410	22.7	2.0		31.2			200	2-
7-23-68	1625	22.7	2.0		31.3			10-	2-
7-24-68	1150	21.5	2.0	7.5	30.4			6000	2-
7-24-68	1320	21.5	2.0		30.5			120	2-
7-24-68	1555	20.9	2.0		30.8	.03		20	2
7-25-68	1210	21.1	2.0	7.2	29.6		.34	20	2-
7-25-68	1415	21.6	2.0		29.4			10-	2-
7-25-68	1600	22.0	2.0	8.0	29.7			20	2-

TABLE B-13

SUMMARY OF FIELD DATA - STATION BH-5

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER II 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4, MG/L	COLIFORM BACTERIA MF TOTAL	COLIFORM BACTERIA MF FECAL
7-23-68	1133	17.5	2.0		31.2			10	2-
7-23-68	1320	19.9	2.0		31.2			10-	2-
7-23-68	1600	23.1	2.0		31.4			10-	2-
7-24-68	1140	16.9	2.0	8.1	30.6			3200	2-
7-24-68	1310	18.0	2.0		30.5			20	2-
7-24-63	1545	20.3	2.0		30.9			60	2-
7-25-68	1200	16.4	2.0	7.9	29.3		.19	10	2-
7-25-68	1405	18.1	2.0		28.9			20	2-
7-25-68	1550	20.6	2.0	7.5	29.4			10-	2-

TABLE B-14

SUMMARY OF FIELD DATA - STATION BH-6

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER II 1968

DATE	TIME	TEMP.	DEPTH	D.O.	SALINITY	NO3-N	TOTAL ORTHO-PHOSPHATE	COLIFORM BACTERIA MF	
		DEG.C	FT.	MG/L	PPT	MG/L	PO4, MG/L	TOTAL	FECAL
7-23-68	1126	19.4	2.0		31.2			40	2-
7-23-68	1335	21.7	2.0		31.3			40	2-
7-23-68	1553	23.3	2.0		31.2			10-	2-
7-24-68	1225	18.4	2.0	8.2	30.7			6700	2-
7-24-68	1355	17.3	2.0		30.3	.05		30	2
7-24-68	1635	16.5	2.0		30.4		.19	260	2
7-25-68	1240	19.3	2.0	8.2	29.5			10	2-
7-25-68	1440	19.3	2.0		29.4			10-	2-
7-25-68	1640	20.1	2.0	9.0	29.6			10-	2-

TABLE B-15

SUMMARY OF FIELD DATA - STATION BH-7

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER II 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4. MG/L	COLIFORM BACTERIA MF TOTAL	FECAL
7-23-68	1120	19.0	2.0		31.3			10-	2-
7-23-68	1330	22.3	2.0		31.1			30	2-
7-23-68	1550	22.4	2.0		31.3			10	2-
7-24-68	1230	15.9	2.0	7.1	30.4			8500	2
7-24-68	1400	18.8	2.0		30.3	.05		10	2
7-24-68	1645	18.3	2.0		30.6		.23	20	2-
7-25-68	1245	19.4	2.0	8.3	29.4			10-	2
7-25-68	1445	19.4	2.0		29.6			10	2-
7-25-68	1645	17.1	2.0	7.5	29.5			10-	2-

TABLE B-16

SUMMARY OF FIELD DATA - STATION BH-8

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER II 1968

DATE	TIME	TEMP.	DEPTH	D.O.	SALINITY	NO3-N	TOTAL ORTHO-PHOSPHATE	COLIFORM BACTERIA MF	
		DEG.C	FT.	MG/L	PPT	MG/L	PO4. MG/L	TOTAL	FECAL
7-23-68	1116	15.1	2.0		31.4			200	10
7-23-68	1326	18.6	2.0		31.2			10	2-
7-23-68	1545	22.2	2.0		31.4			10-	2-
7-24-68	1235	16.5	2.0	7.2	30.4			5200	20
7-24-68	1430	17.9	2.0		30.6	.04		10-	2-
7-24-68	1455	18.2	2.0		30.6		.23	50	2-
7-25-68	1245	15.7	2.0	7.8	31.1			10	2
7-25-68	1450	18.0	2.0		29.1			20	2-
7-25-68	1655	17.4	2.0	8.5	29.7			10	2

TABLE B-17

SUMMARY OF FIELD DATA - STATION BH-9

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER II 1968

DATE	TIME	TEMP.	DEPTH	D.O.	SALINITY	NO3-N	TOTAL ORTHO-PHOSPHATE	COLIFORM BACTERIA MF	
		DEG.C	FT.	MG/L	PPT	MG/L	PO4. MG/L	TOTAL	FECAL
7-23-68	1110	14.9	2.0		31.3			100	12
7-23-68	1320	16.2	2.0		31.2			700	64
7-23-68	1540	16.8	2.0		31.3			510	28
7-24-68	1217	15.1	2.0	8.2	30.8			7800	6
7-24-68	1445	15.2	2.0		31.1	.06		870	42
7-24-68	1645	-0.0	2.0		30.6		.16-	590	54
7-25-68	1230	14.5	2.0	8.5	31.5			60	10
7-25-68	1450	15.5	2.0		31.1			360	10
7-25-68	1710	15.7	2.0	8.5	31.1			2000	60

TABLE B-18

SUMMARY OF FIELD DATA - STATION BH-10

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER II 1968

DATE	TIME	TEMP.	DEPTH	D.O.	SALINITY	NO3-N	TOTAL ORTHO-PHOSPHATE	COLIFORM BACTERIA MF	
		DEG.C	FT.	MG/L	PPT	MG/L	PO4, MG/L	TOTAL	FECAL
7-23-68	1100	14.8	2.0		31.3			10-	2-
7-23-68	1312	17.6	2.0		31.0			10	2-
7-23-68	1530	17.1	2.0		31.0			10	2
7-24-68	1207	16.8	2.0	9.6	30.8			6300	2
7-24-68	1435	15.9	2.0		30.9	.04		20	2-
7-24-68	1600	-0.0	2.0				.16	230	6
7-25-68	1210	14.5	2.0	9.5	31.5			10-	2-
7-25-68	1445	14.5	2.0		31.3			10-	2-
7-25-68	1700	15.2	2.0	9.0	31.2			120	6

TABLE B-19

SUMMARY OF FIELD DATA - STATION BH-11

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER II 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4. MG/L	COLIFORM BACTERIA MF TOTAL	COLIFORM BACTERIA MF FECAL
7-23-68	1210	19.0	2.0		31.1			100	2-
7-23-68	1436	20.7	2.0		30.9			30	2-
7-23-68	1640	22.3	2.0		30.8			20	2
7-24-68	1130	18.8	2.0	7.1	30.3			30	6
7-24-68	1305	20.5	2.0		30.3	.04		8300	2-
7-24-68	1530	20.4	2.0		30.3		.29	20	2-
7-25-68	1150	18.8	2.0	6.9	29.2			20	2-
7-25-68	1355	20.1	2.0		29.2			10-	2-
7-25-68	1540	21.0	2.0	7.0	28.8			40	2

TABLE B-20

SUMMARY OF FIELD DATA - STATION BH-12

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER II 1968

DATE	TIME	TEMP.	DEPTH	D.O.	SALINITY	NO3-N	TOTAL ORTHO-PHOSPHATE	COLIFORM BACTERIA MF	
		DEG.C	FT.	MG/L	PPT	MG/L	PO4. MG/L	TOTAL	FECAL
7-23-68	1215	21.2	2.0		30.6			100	2-
7-23-68	1445	23.1	2.0		30.5			100	6
7-23-68	1645	23.9	2.0		30.4			70	4
7-24-68	1120	21.3	2.0	7.0	30.0			20	4
7-24-68	1300	22.0	2.0		30.0	.05		50	2-
7-24-68	1510	22.4	2.0		29.8		.36	60	4
7-25-68	1140	21.2	2.0	6.5	28.8			60	2
7-25-68	1345	21.5	2.0		28.9			20	2
7-25-68	1535	23.1	2.0	7.0	28.5			110	8

TABLE B-21

SUMMARY OF FIELD DATA - STATION BA

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER III 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4. MG/L	COLIFORM BACTERIA MF TOTAL	COLIFORM BACTERIA MF FECAL
7-30-68	945	15.8	2.0	8.0	30.1		.15	110	4
7-30-68	1430	13.4	2.0		30.1		.15	1200	1500
7-30-68	1225	13.5	2.0	8.0	30.0		.14	100	50
7-31-68	959	16.6	2.0	8.0	29.9	.07	.14	200	10
7-31-68	1252	14.4	2.0	8.3	31.9	.09	.12	380	32
7-31-68	1519	16.4	2.0		31.9	.11	.14	50000	3500
8- 1-68	1045	16.4	2.0	8.2	31.4	.08	.12	270	30
8- 1-68	1330	15.6	2.0	8.7	31.3	.06	.12		
8- 1-68	1555	13.2	2.0	8.5	31.5	.07	.14	47000	2700

TABLE B-22

SUMMARY OF FIELD DATA - STATION BB

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER III 1968

DATE	TIME	TEMP.	DEPTH	D.O.	SALINITY	NO3-N	TOTAL ORTHO-PHOSPHATE	COLIFORM BACTERIA MF	
		DEG.C	FT.	MG/L	PPT	MG/L	PO4. MG/L	TOTAL	FECAL
7-30-68	930	16.1	2.0	7.2	29.4		.20	490	62
7-30-68	1201	16.0	2.0	6.8	29.4		.17	110	66
7-30-68	1420	14.8	2.0		29.8		.15	40	12
7-31-68	946	17.1	2.0	7.4	29.8	.05	.20	2200	86
7-31-68	1220	16.3	2.0	8.6	32.3	.10	.15	90	14
7-31-68	1505	16.6	2.0		30.7	.07	.14	250	24
8- 1-68	1030	16.3	2.0	7.2	30.7	.07	.20	3900	240
8- 1-68	1320	15.6	2.0	8.4	31.2	.06	.14	90	20
8- 1-68	1545	14.7	2.0	8.0	31.4	.08	.13	570	64

TABLE B-23

SUMMARY OF FIELD DATA - STATION BC

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER III 1968

DATE	TIME	TEMP.	DEPTH	D.O.	SALINITY	NO3-N	TOTAL ORTHO-PHOSPHATE	COLIFORM BACTERIA MF	
		DEG.C	FT.	MG/L	PPT	MG/L	PO4. MG/L	TOTAL	FECAL
7-30-68	1115	16.7	2.0	8.0	30.9		.20	230	200
7-30-68	1313	15.9	2.0	8.5	30.2		.17	10-	6
7-30-68	1510	16.6	2.0		30.1		.18	300	240
7-31-68	1128	17.8	2.0	7.8	31.1	.06	.23	40	2-
7-31-68	1355	16.7	2.0	8.4	32.4	.09	.15	40	2
7-31-68	1614	17.5	2.0		30.8	.05	.14	40000	3900
8- 1-68	1220	18.0	2.0	8.2	31.4			50	6
8- 1-68	1435	15.7	2.0	8.5	31.6	.06	.19	80	4
8- 1-68	1635	18.1	2.0	8.8	31.2	.06	.17	360	64

TABLE B-24

SUMMARY OF FIELD DATA - STATION 6D

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER III 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4. MG/L	COLIFORM BACTERIA MF TOTAL	COLIFORM BACTERIA MF FECAL
7-30-68	1040	15.0	2.0	8.4	32.3		.23	440	20
7-30-68	1210	15.5	2.0	8.4	31.4		.19	2800	110
7-30-68	1441	13.7	2.0	9.2	32.2		.13	40	4
7-31-68	1100	14.7	2.0	9.0	31.1	.06	.29	60	2
7-31-68	1310	14.6	2.0	8.6	31.6	.08	.13	460	10
7-31-68	1535	13.4	2.0		31.5	.09	.20	50	4
8- 1-68	1145	16.3	2.0	8.2	30.3	.04	.27	120	10
8- 1-68	1350	15.2	2.0	8.5	30.5	.04	.17	330	10
8- 1-68	1557	13.7	2.0	8.9	30.7	.05	.17	100	2-

TABLE B-25

SUMMARY OF FIELD DATA - STATION BH-13

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER III 1968

DATE	TIME	TEMP.	DEPTH	D.O.	SALINITY	NO3-N	TOTAL ORTHO-PHOSPHATE	COLIFORM BACTERIA MF	
		DEG.C	FT.	MG/L	PPT	MG/L	PO4. MG/L	TOTAL	FECAL
7-30-68	1040	17.6	2.0	7.7	30.2		.22	10-	2-
7-30-68	1350	18.7	2.0	8.3	31.5		.22	10-	2-
7-30-68	1510	18.2	2.0	6.0	32.0		.23	10-	2-
7-31-68	1047	18.5	2.0	8.1	30.9	.07	.23	10-	2-
7-31-68	1335	18.2	2.0	7.8	29.5	.07	.23	10-	2-
7-31-68	1610	18.2	2.0		31.4	.05	.23	10-	2-
8- 1-68	1145	18.3	2.0	7.7	31.5	.06	.25	20	2-
8- 1-68	1425	18.5	2.0	7.8	30.7	.07	.23	4	2-
8- 1-68	1635	19.2	2.0	8.4	30.9	.04	.27	2	2-

TABLE B-26

SUMMARY OF FIELD DATA - STATION BH-14

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER III 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4. MG/L	COLIFORM BACTERIA MF TOTAL	COLIFORM BACTERIA MF FECAL
7-30-68	1045	18.3	2.0	8.6	30.3		.26	10-	2-
7-30-68	1240	19.1	2.0	9.0	31.5		.23	10-	2-
7-30-68	1504	19.0	2.0	6.7	31.9		.22	10-	2-
7-31-68	1054	19.0	2.0	8.4	30.1	.10	.26	10-	2-
7-31-68	1340	18.5	2.0	8.3	31.5	.05	.24	10-	2-
7-31-68	1605	18.5	2.0		31.4	.04	.23	10-	2-
8- 1-68	1155	18.8	2.0	7.9	31.4	.06	.26	10-	2-
8- 1-68	1417	19.1	2.0	8.1	30.8	.15	.24	4	2-
8- 1-68	1625	18.9	2.0	8.3	30.9	.03	.26	4-	2-

TABLE B-27

SUMMARY OF FIELD DATA - STATION BH-15

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER III 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4. MG/L	COLIFORM BACTERIA MF TOTAL	FECAL
7-30-68	1055	18.3	2.0	7.8	30.4		.23	10	2-
7-30-68	1235	19.6	2.0	7.8	31.4		.25	10-	2-
7-30-68	1456	19.7	2.0	6.4	28.6		.25	10-	2-
7-31-68	1104	18.8	2.0	8.8	30.6	.07	.23	10-	2-
7-31-68	1330	17.3	2.0	8.1	31.4	.08	.24	10-	2-
7-31-68	1555	18.6	2.0		31.4	.09	.24	10-	2-
8- 1-68	1200	17.5	2.0	7.7	31.6	.07	.21	10-	2-
8- 1-68	1413	22.4	2.0	8.0	30.7	.09	.22	10	2-
8- 1-68	1616	18.7	2.0	9.1	30.9	.05	.22	2-	2-

TABLE B-28

SUMMARY OF FIELD DATA - STATION BH-16

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER III 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4. MG/L	COLIFORM BACTERIA MF	
								TOTAL	FECAL
7-30-68	1051	16.1	2.0	8.4	28.7		.21	10-	2-
7-30-68	1222	17.4	2.0	8.1	31.5		.18	10-	2-
7-30-68	1448	16.2	2.0	4.7	29.7		.17	20	6
7-31-68	1112	17.0	2.0	5.3	31.8	.07	.19	10-	2-
7-31-68	1320	17.0	2.0	8.6	31.6	.09	.18	20	2-
7-31-68	1545	17.1	2.0		31.5	.08	.19	10-	2-
8- 1-68	1155	17.1	2.0	8.3	30.3	.04	.17	20	2
8- 1-68	1404	18.6	2.0	8.0	30.5	.05	.18	140	8
8- 1-68	1600	16.3	2.0	8.5	30.8	.05	.18	30	2

TABLE 6-29

SUMMARY OF FIELD DATA - STATION BH-17

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER III 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4. MG/L	COLIFORM BACTERIA MF TOTAL	COLIFORM BACTERIA MF FECAL
7-30-68	1030	17.0	2.0	7.7	30.2		.23	10-	2-
7-30-68	1305	16.2	2.0	8.5	30.3		.19	40	16
7-30-68	1518	15.5	2.0	6.3	30.4	.06	.17		
7-31-68	1027	16.8	2.0	7.6	29.6	.10	.21	60	2
7-31-68	1327	17.4	2.0	8.3	29.5	.08	.17	20	2
7-31-68	1556	17.3	2.0		27.1	.08	.18	10	2-
8- 1-68	1140	16.0	2.0	8.0	31.5	.05	.17	200	6
8- 1-68	1410	15.2	2.0	8.4	31.5	.07	.17	74	6
8- 1-68	1630	16.0	2.0	8.4	31.6	.06	.17	46	2

TABLE B-30

SUMMARY OF FIELD DATA - STATION BH-18

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER III 1968

DATE	TIME	TEMP.	DEPTH	D.O.	SALINITY	NO3-N	TOTAL ORTHO-PHOSPHATE	COLIFORM BACTERIA MF	
		DEG.C	FT.	MG/L	PPT	MG/L	PO4, MG/L	TOTAL	FECAL
7-30-68	1020	15.1	2.0	8.2	29.9		.62	8000	200
7-30-68	1250	14.3	2.0	8.2	29.8		.63	3100	1000-
7-30-68	1452	12.4	2.0		29.8		.74	1000	100-
7-31-68	1029	15.8	2.0	7.8	31.4	.08	.55	400	10
7-31-68	1320	15.8	2.0	8.5	31.9	.09	.35	800	10
7-31-68	1549	15.2	2.0		32.6	.11	.81	1800	10
8- 1-68	1120	15.0	2.0	8.2	30.8	.06	.37	700	2-
8- 1-68	1405	13.7	2.0	8.5	31.5	.06	.90	2800	20
8- 1-68	1620	11.8	2.0	8.9	31.1	.06	.85	100	10-

TABLE B-31

SUMMARY OF FIELD DATA - STATION BH-19

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER III 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4. MG/L	COLIFORM BACTERIA MF TOTAL	COLIFORM BACTERIA MF FECAL
7-30-68	1010	16.1	2.0		30.1		.18	10-	2-
7-30-68	1240	15.0	2.0	8.7	30.2		.15	10	6
7-30-68	1446	14.5	2.0		30.5		.15	40	12
7-31-68	1021	17.3	2.0	7.9	28.9	.10	.20	10-	2-
7-31-68	1312	16.5	2.0	8.8	30.2	.06	.21	10	2
7-31-68	1542	16.5	2.0		30.4	.07	.20	10	2
8- 1-68	1110	15.3	2.0	8.3	31.4	.07	.15	30	8
8- 1-68	1355	16.5	2.0	8.4	31.5	.05	.14	30	4
8- 1-68	1615	15.1	2.0	8.6	31.6	.06	.14	68	2-

TABLE B-32

SUMMARY OF FIELD DATA - STATION BH-20

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER III 1968

DATE	TIME	TEMP.	DEPTH	D.O.	SALINITY	NO3-N	TOTAL ORTHO-PHOSPHATE	COLIFORM BACTERIA MF	
		DEG.C	FT.	MG/L	PPT	MG/L	PO4. MG/L	TOTAL	FECAL
7-30-68	1000	14.8	2.0	8.5	30.2		.14	250	52
7-30-68	1235	13.4	2.0	9.0	30.3		.14	130	12
7-30-68	1440	13.5	2.0		30.4		.13	10-	4
7-31-68	1012	15.3	2.0	8.3	30.6	.04	.15	10	2-
7-31-68	1305	15.8	2.0	9.1	30.7	.05	.10	110	8
7-31-68	1534	19.8	2.0		29.6	.07	.12	50	4
8- 1-68	1100	15.2	2.0	8.3	31.3	.07	.15	40	2
8- 1-68	1345	15.2	2.0	8.3	31.3	.06	.12	70	2
8- 1-68	1610	13.7	2.0	9.2	31.6	.04	.11	60	10

TABLE B-33

SUMMARY OF FIELD DATA - STATION BH-21

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER III 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4, MG/L	COLIFORM BACTERIA MF TOTAL	FECAL
7-30-68	1026	16.7	2.0	8.0	32.5		.18	20	2
7-30-68	1200	15.3	2.0	8.6	31.2		.22	720	40
7-30-68	1434	15.2	2.0	5.7	32.2		.18	520	62
7-31-68	1047	16.1	2.0	7.9	31.4	.11	.18	170	6
7-31-68	1300	15.1	2.0	8.5	31.3	.07	.10-	390	6
7-31-68	1525	14.8	2.0		31.7	.08	.18	60	2
8- 1-68	1135	16.7	2.0	8.0	30.5	.05	.18	140	8
8- 1-68	1342	15.7	2.0	8.4	30.3	.04	.26	210	4
8- 1-68	1550	15.1	2.0	8.5	30.6	.05	.18	210	16

TABLE B-34

SUMMARY OF FIELD DATA - STATION BH-22

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER III 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4, MG/L	COLIFORM BACTERIA MF TOTAL	FECAL
7-30-68	1027	17.8	2.0	7.5	31.5		.23	40	2
7-30-68	1155	18.8	2.0	7.8	31.4		.22	10-	2-
7-30-68	1426	16.9	2.0	6.0	32.3		.18	10-	2-
7-31-68	1040	18.4	2.0	7.7	31.3	.07	.23	10	2
7-31-68	1255	17.9	2.0	8.0	31.4	.06	.21	10-	2-
7-31-68	1520	15.6	2.0		31.5	.10	.21	10	4
8- 1-68	1125	18.8	2.0	9.5	30.4	.04	.22	40000	2800
8- 1-68	1335	17.8	2.0	7.9	30.4	.05	.20	34	2
8- 1-68	1545	17.6	2.0	8.3	30.6	.04	.21	28	2-

TABLE B-35

SUMMARY OF FIELD DATA - STATION BH-23

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER III 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4, MG/L	COLIFORM BACTERIA MF TOTAL	FECAL
7-30-68	1017	18.9	2.0	7.3	31.5		.25	40	6
7-30-68	1145	19.4	2.0	7.4	31.3		.24	10-	2
7-30-68	1418	18.7	2.0	6.1	32.0		.22	10-	2-
7-31-68	1030	19.1	2.0	6.5	31.2	.08	.22	60	4
7-31-68	1245	18.0	2.0	7.9	31.2	.06	.22	60	6
7-31-68	1510	17.3	2.0		31.4	.09	.22	10-	2-
8- 1-68	1120	19.9	2.0	7.5	30.3	.03	.26	40	6
8- 1-68	1328	18.7	2.0	7.7	30.1	.03	.24	72	2
8- 1-68	1537	18.3	2.0	8.1	30.7	.04	.24	30	2-

TABLE B-36

SUMMARY OF FIELD DATA - STATION BH-24

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER III 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4. MG/L	COLIFORM BACTERIA MF TOTAL	COLIFORM BACTERIA MF FECAL
7-30-68	1001	19.5	2.0	7.3	30.0		.28	120	2
7-30-68	1137	19.7	2.0	7.0	31.6		.26	100	18
7-30-68	1410	20.2	2.0	6.9	30.3		.27	120	22
7-31-68	1024	20.0	2.0	7.4	31.0	.08	.26	60	2
7-31-68	1238	20.4	2.0	7.4	31.0	.07	.25	100	2
7-31-68	1505	19.3	2.0		31.3	.06	.25	70	2-
8- 1-68	1110	20.7	2.0	7.3	29.8	.05	.27	160	10
8- 1-68	1320	21.4	2.0	7.5	29.9	.05	.27	54	12
8- 1-68	1529	19.7	2.0	7.2	30.2	.05	.26	160	26

TABLE B-37

SUMMARY OF FIELD DATA - STATION BH-25

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER III 1968

DATE	TIME	TEMP.	DEPTH	D.O.	SALINITY	NO3-N	TOTAL ORTHO-PHOSPHATE	COLIFORM BACTERIA MF	
		DEG.C	FT.	MG/L	PPT	MG/L	PO4, MG/L	TOTAL	FECAL
7-30-68	954	18.3	2.0	7.2	30.9		.24	200	2
7-30-68	1130	19.1	2.0	7.3	31.2		.25	10	2
7-30-68	1404	20.2	2.0	7.1	30.2		.26	10-	2-
7-31-68	1015	18.9	2.0	7.6	31.1	.04	.26	40	20
7-31-68	1230	19.1	2.0	7.9	31.1	.07	.25	50	10
7-31-68	1445	19.7	2.0		31.0	.07	.26	30	4
8- 1-68	1055	20.8	2.0	8.0	29.8	.05	.29	130	4
8- 1-68	1310	22.2	2.0	8.8	29.7	.05	.26	16	2
8- 1-68	1522	24.0	2.0	9.0	30.2	.05	.26	56	2-

TABLE B-38

SUMMARY OF FIELD DATA - STATION 8A

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER IV 1968

DATE	TIME	TEMP.	DEPTH	D.O.	SALINITY	NO3-N	TOTAL ORTHO-PHOSPHATE	COLIFORM BACTERIA MF	
		DEG.C	FT.	MG/L	PPT	MG/L	PO4, MG/L	TOTAL	FECAL
8- 6-68	600	13.7	2.0	8.1	31.7			16000	960
8- 6-68	600	13.4	15.0	5.9	31.8			17000	170
8- 6-68	815	13.7	2.0	8.4	31.4		.18	91000	3700
8- 6-68	815	13.4	16.0	8.4	31.5		.17	81000	4000
8- 6-68	1105	15.5	2.0	8.1	30.8			1400	90
8- 6-68	1105	14.9	20.0	8.5	30.4			40000	7800
8- 6-68	1525	15.5	2.0	8.5	31.1		.16	2300	140
8- 6-68	1525	14.7	12.0	8.8	30.9		.13	160	16
8- 6-68	1810	15.2	2.0	9.3	31.2			1600	210
8- 6-68	1810	14.6	15.0	8.4	31.1			3500	390
8- 7-68	555	16.0	2.0	7.8	31.1			4600	300
8- 7-68	555	13.8	9.0	8.2	31.5			4700	200
8- 7-68	820	14.7	2.0	8.3	30.4		.17	16000	950
8- 7-68	820	13.7	15.0	8.1	30.5		.17	67000	3800
8- 7-68	1115	14.9	2.0	8.5	30.9			5600	62
8- 7-68	1115	13.8	20.0	9.0	30.9			17000	610
8- 7-68	1630	15.8	2.0	8.0	30.9		.20	4300	190
8- 7-68	1630	13.8	17.0	8.7	31.2		.19	8800	460
8- 7-68	1845	14.9	2.0	8.8	30.8			265000	16000

TABLE B-38(CONT.)

SUMMARY OF FIELD DATA - STATION 6A

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER IV 1968

DATE	TIME	TEMP.	DEPTH	D.O.	SALINITY	NO3-N	TOTAL ORTHO- PHOSPHATE	COLIFORM BACTERIA MF	
		DEG.C	FT.	MG/L	PPT	MG/L	PO4. MG/L	TOTAL	FECAL
8- 7-68	1845	14.0	14.0	8.3	31.8			10300	500
8- 8-68	550	15.8	2.0	8.1	31.2			12000	350
8- 8-68	550	13.6	10.0	7.3	31.4			10000	340
8- 8-68	813	15.0	2.0	7.5	31.0		.18	36000	300
8- 8-68	813	14.0	15.0	8.0	31.3		.25	10000	620
8- 8-68	1125	14.3	2.0	8.3	31.2			4100	290
8- 8-68	1125	14.2	20.0	8.7	30.9			5700	300
8- 8-68	1515	20.3	2.0	8.6	30.5		.17	210	10
8- 8-68	1515	16.3	15.0	8.6	30.6		.19	4300	100
8- 8-68	1805	16.7	2.0	7.9	30.5			620	40
8- 8-68	1808	14.2	15.0	9.1	31.1			1500	60

TABLE B-39

SUMMARY OF FIELD DATA - STATION BB

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER IV 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4. MG/L	COLIFORM BACTERIA MF TOTAL	COLIFORM BACTERIA MF FECAL
8- 6-68	700	15.9	2.0	8.2	31.4			850	130
8- 6-68	700	15.6	15.0	8.2	31.5			830	120
8- 6-68	905	15.1	2.0	8.5	31.3		.17	2500	150
8- 6-68	905	14.5	25.0	8.0	31.3		.17	37000	400
8- 6-68	1155	16.6	2.0	8.4	31.0			60	6
8- 6-68	1155	14.4	25.0	8.1	30.9			7200	610
8- 6-68	1500	17.4	2.0	8.2	30.5		.21	460	150
8- 6-68	1500	15.9	15.0	8.2	30.7		.21	280	86
8- 6-68	1750	16.5	2.0	8.4	30.8			450	50
8- 6-68	1750	15.6	25.0	8.2	30.9			730	132
8- 7-68	650	15.9	2.0		30.8			60	56
8- 7-68	650	15.5	15.0	7.5	30.8			2200	98
8- 7-68	905	15.3	2.0	8.1	31.2			5900	290
8- 7-68	905	14.5	25.0	8.1	31.2		.17	7800	330
8- 7-68	1200	16.0	2.0	8.1	30.7			550	42
8- 7-68	1200	14.1	25.0	8.2	31.0			12000	500
8- 7-68	1600	17.0	2.0	7.4	29.8		.20	810	96
8- 7-68	1600	16.1	17.0	7.4	30.6		.22	530	62
8- 7-68	1830	14.9	2.0	7.4	30.4			370	50

TABLE B-39(CONT.)

SUMMARY OF FIELD DATA - STATION BB

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER IV 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4. MG/L	COLIFORM BACTERIA MF TOTAL	COLIFORM BACTERIA MF FECAL
8- 7-68	1830	14.0	17.0	7.4	30.0			730	36
8- 8-68	645	16.5	2.0	6.7	30.2			25000	4500
8- 8-68	645	16.0	15.0	6.0	30.9			9000	660
8- 8-68	855	16.1	2.0	6.8	30.5		.22	37000+	4300+
8- 8-68	855	15.0	20.0	7.2	31.3		.19	16000	1200
8- 8-68	1215	15.9	2.0	8.0	30.9			1800	130
8- 8-68	1215	13.6	25.0	7.8	30.9		.22	8800	390
8- 8-68	1500	19.5	2.0	6.8	28.9			120	34
8- 8-68	1500	14.7	17.0	7.8	30.7		.16	3500	240
8- 8-68	1750	18.4	2.0	7.0	29.3			11000	560
8- 8-68	1750	17.0	17.0	7.1	29.9			11000	880

TABLE B-40

SUMMARY OF FIELD DATA - STATION BC

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER IV 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4, MG/L	COLIFORM BACTERIA MF TOTAL	COLIFORM BACTERIA MF FECAL
8- 6-68	640	16.0	2.0	7.8	31.7		.22	32000	2700
8- 6-68	640	16.0	6.0	7.8	31.8			30000	2900
8- 6-68	855	15.5	2.0	8.2	31.5		.19	6900	900
8- 6-68	855	15.0	10.0	8.1	31.4		.20	16000	1200
8- 6-68	1140	17.9	2.0	7.8	31.3			1400	160
8- 6-68	1140	15.7	12.0	7.8	30.8			8100	790
8- 6-68	1615	17.1	2.0	8.9	31.4		.22	1700	180
8- 6-68	1615	16.9	10.0	7.7	31.3				
8- 6-68	1850	15.8	10.0	8.9	31.2			1700	210
8- 6-68	1850	15.8	2.0	8.8	31.4			960	142
8- 7-68	635	16.2	2.0	7.3	31.7			110	2-
8- 7-68	635	16.2	6.0	7.4	31.5			170	2-
8- 7-68	955	15.8	2.0	8.1	31.3		.17	8100	490
8- 7-68	955	15.0	9.0	8.0	31.4		.18	1700	1600
8- 7-68	1145	16.6	2.0	7.4	30.8			3500	190
8- 7-68	1145	15.4	10.0	8.0	30.8			8100	500
8- 7-68	1710	16.9	2.0	8.1	29.9		.23	67000	3600
8- 7-68	1710	16.2	10.0	7.9	30.6		.25	39000	22000
8- 7-68	1920	16.2	2.0	8.0	31.2			700000+	4000+

TABLE B-40(CONT.)

SUMMARY OF FIELD DATA - STATION BC

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER IV 1968

DATE	TIME	TEMP.	DEPTH	D.O.	SALINITY	NO3-N	TOTAL ORTHO-PHOSPHATE	COLIFORM BACTERIA MF	
		DEG.C	FT.	MG/L	PPT	MG/L	PO4. MG/L	TOTAL	FECAL
8- 7-68	1920	16.2	9.0	7.8	31.2			18000	2300
8- 8-68	630	16.1	2.0	7.0	30.7			500000+	50000+
8- 8-68	630	16.1	11.0	6.0	31.1			180000	20000
8- 8-68	845	15.7	2.0	7.3	31.0		.21	46000	4600
8- 8-68	845	15.6	8.0	7.2	31.1		.21	16000	2700
8- 8-68	1200	16.3	2.0	7.0	30.6			16000	2700
8- 8-68	1200	14.9	13.0	7.7	31.1			19000	1500
8- 8-68	1600	17.1	2.0	8.3	30.6		.31	400000	2900
8- 8-68	1600	16.4	7.5	7.4	30.8			13000	1500
8- 8-68	1840	17.9	2.0	7.9	31.3			500000+	50000+

TABLE B-41

SUMMARY OF FIELD DATA - STATION BD

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER IV 1968

DATL	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4. MG/L	COLIFORM BACTERIA MF TOTAL	 FECAL
8- 6-68	623	14.5	2.0	8.1	31.7			2300	20
8- 6-68	623	14.4	30.0	8.3	31.8			900	10
8- 6-68	835	14.0	2.0	8.5	31.6		.17	470	16
8- 6-68	835	13.8	35.0	8.5	31.5			360	12
8- 6-68	1125	15.4	2.0	8.4	31.3			100	4
8- 6-68	1125	14.2	25.0	8.6	30.9			130	2-
8- 6-68	1600	15.3	2.0	8.5	31.3		.19	40	2
8- 6-68	1600	15.4	20.0	8.6	31.3		.18	20	4
8- 6-68	1830	14.8	2.0	8.8	31.5			2300	170
8- 6-68	1830	14.8	40.0	8.5	31.5			410	320
8- 7-68	620	13.9	2.0	8.3	31.5			1800	124
8- 7-68	620	13.8	20.0	8.3	31.4			1300	32
8- 7-68	840	14.0	2.0	8.5	30.6		.17	1200	38
8- 7-68	840	14.9	35.0	8.3	30.5		.16	870	36
8- 7-68	1130	14.0	2.0	8.4	31.1			290	6
8- 7-68	1130	13.0	30.0	9.0	31.5			390	34
8- 7-68	1650	15.9	2.0	8.3	30.6		.18	30	2
8- 7-68	1650	14.8	25.0	8.2	31.4		.21	180	6
8- 7-68	1905	14.7	2.0	8.3	31.3			14600	310

TABLE B-41(CONT.)

SUMMARY OF FIELD DATA - STATION 8D

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER IV 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4, MG/L	COLIFORM BACTERIA MF TOTAL	 FECAL
8- 7-68	1905	14.2	30.0	8.3	31.6			300	8
8- 8-68	615	15.3	2.0	7.7	31.3			2600	180
8- 8-68	615	15.1	20.0	7.7	31.3			2100	64
8- 8-68	829	14.4	2.0	7.6	31.5		.21	3200	150
8- 8-68	829	14.3	30.0	8.0	31.5		.21	3800	170
8- 8-68	1145	12.9	2.0	9.0	31.9			120	4
8- 8-68	1145	12.0	35.0	9.0	31.9			120	8
8- 8-68	1540	15.9	2.0	8.4	30.8		.20	30	2
8- 8-68	1540	13.7	35.0	8.2	31.0		.19	100	6
8- 8-68	1825	15.9	2.0	8.4	31.3			190	20
8- 8-68	1825	15.8	25.0	8.4	31.3			110	6

TABLE B-42

SUMMARY OF FIELD DATA - STATION BA

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER V 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4. MG/L	COLIFORM BACTERIA MF	
								TOTAL	FECAL
8-13-68	905	16.1	2.0	7.9	31.2	.08	.17	100-	10-
8-13-68	1150	16.4	2.0	8.6	30.7	.03	.14	100-	10-
8-13-68	1450	15.4	2.0	8.6	30.9	.04	.13	6100	460
8-14-68	1025	17.2	2.0	8.0	31.0	.06	.16	20	6
8-14-68	1150	18.2	2.0	9.0	30.5	.07	.14	10	4
8-14-68	1550	16.0	2.0	8.9	30.6	.08	.14	1000	10
8-15-68	1100	16.8	2.0	8.3	30.8	.04	.15	2100	160
8-15-68	1405	16.2	2.0	8.7	30.8	.04	.14	1200	360
8-15-68	1700	16.4	2.0		31.1	.04	.13	3200	240

TABLE B-43

SUMMARY OF FIELD DATA - STATION BH-26

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER V 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4, MG/L	COLIFORM BACTERIA MF TOTAL	COLIFORM BACTERIA MF FECAL
8-13-68	922	15.6	2.0	8.0	31.1	.05	.15	3000	400
8-13-68	1225	15.1	2.0	8.9	30.7	.02	.21	80000	6100
8-13-68	1525	15.4	2.0	8.7	30.8	.03	.25	10000	300
8-14-68	1055	15.3	2.0	8.3	30.3	.07	.27	2800	160
8-14-68	1325	15.0	2.0	8.7	30.1	.06	.27	33000	900
8-14-68	1615	15.6	2.0	8.7	30.4	.06	.35	1500000+	50000+
8-15-68	1135	14.4	2.0	8.1	30.4	.04	.36	160000	9000
8-15-68	1435	15.9	2.0	8.7	30.6	.03	.24	19000	680
8-15-68	1730	15.7	2.0	9.4	31.4	.03	.14	9100	760

TABLE B-44

SUMMARY OF FIELD DATA - STATION BH-27

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER V 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4, MG/L	COLIFORM BACTERIA MF TOTAL	FECAL
8-13-68	955	15.0	2.0	8.3	31.2	.06	.15	100	10-
8-13-68	1230	14.7	2.0	10.3	31.5	.02	.10	100-	20
8-13-68	1530	14.2	2.0	10.1	31.5	.04	.10	100-	10
8-14-68	1100	15.5	2.0	8.5	30.9	.08	.18	640	72
8-14-68	1330	14.2	2.0	9.7	31.2	.07	.10	310	22
8-14-68	1625	14.5	2.0	9.4	31.1	.07	.14	2300	170
8-15-68	1140	14.7	2.0	8.7	31.2	.04	.21	35000	3000
8-15-68	1445	13.8	2.0	9.9	31.2	.04	.10	2100	210
8-15-68	1735	13.7	2.0	9.6	31.7	.03	.10-	12000	880

TABLE B-45

SUMMARY OF FIELD DATA - STATION BH-28

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER V 1968

DATE	TIME	TEMP.	DEPTH	D.O.	SALINITY	NO3-N	TOTAL ORTHO-PHOSPHATE	COLIFORM BACTERIA MF	
		DEG.C	FT.	MG/L	PPT	MG/L	PO4, MG/L	TOTAL	FECAL
8-13-68	1000	15.2	2.0	8.2	31.2	.04	.14	1300	60
8-13-68	1235	15.2	2.0	9.0	31.3	.05	.12	100	10-
8-13-68	1535	15.6	2.0	9.2	31.1	.04	.14	100-	10-
8-14-68	1105	15.9	2.0	8.4	31.1	.05	.13	2100	170
8-14-68	1335	15.3	2.0	9.0	31.0	.05	.12	90	6
8-14-68	1630	15.7	2.0	9.1	31.1	.06	.14	50	8
8-15-68	1147	15.4	2.0	8.8	31.3	.04	.14	8200	490
8-15-68	1450	15.0	2.0	9.1	31.3	.03	.12	5000	340
8-15-68	1745	14.9	2.0	9.4	31.3	.03	.11	1700	230

TABLE B-46

SUMMARY OF FIELD DATA - STATION BH-29

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER V 1968

DATE	TIME	TEMP.	DEPTH	D.O.	SALINITY	NO3-N	TOTAL ORTHO-PHOSPHATE	COLIFORM BACTERIA MF	
		DEG.C	FT.	MG/L	PPT	MG/L	PO4. MG/L	TOTAL	FECAL
8-13-68	1010	14.8	2.0	8.3	31.3	.05	.14	1700	50
8-13-68	1240	15.5	2.0	8.3	31.2	.05	.16	100	10-
8-13-68	1545	14.7	2.0	9.0	31.3	.04	.12	100-	10-
8-14-68	1115	16.2	2.0	8.4	31.1	.06	.13	880	96
8-14-68	1345	16.2	2.0	8.4	30.9	.07	.16	10	2-
8-14-68	1635	15.1	2.0	9.2	31.1	.08	.12	110	12
8-15-68	1155	15.2	2.0	8.8	31.4	.05	.14	1300	620
8-15-68	1500	15.6	2.0	9.0	30.8	.04	.16	130	10
8-15-68	1750	14.4	2.0	9.5	31.3	.04	.12	230	32

TABLE B-47

SUMMARY OF FIELD DATA - STATION BH-30

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER V 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4. MG/L	COLIFORM BACTERIA MF TOTAL	COLIFORM BACTERIA MF FECAL
8-13-68	1015	15.6	2.0	8.1	31.0	.05	.16	1600	110
8-13-68	1245	14.8	2.0	8.6	31.2	.02	.12	300	10-
8-13-68	1550	15.4	2.0	9.7	31.7	.04	.11	100-	10-
8-14-68	1120	16.2	2.0	8.4	30.9	.06	.14	740	130
8-14-68	1350	15.2	2.0	8.8	30.7	.09	.12	200	6
8-14-68	1645	14.8	2.0	9.5	31.2	.08	.09	100	10
8-15-68	1205	15.8	2.0	8.6	31.2	.06	.13	15000	1100
8-15-68	1505	15.1	2.0	9.1	31.1	.04	.13	4800	220
8-15-68	1800	14.4	2.0	9.5	31.4			50000+	5000+

TABLE B-48

SUMMARY OF FIELD DATA - STATION BH-31

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER V 1968

DATE	TIME	TEMP.	DEPTH	D.O.	SALINITY	NO3-N	TOTAL ORTHO-PHOSPHATE	COLIFORM BACTERIA MF	
		DEG.C	FT.	MG/L	PPT	MG/L	PO4, MG/L	TOTAL	FECAL
8-13-68	1020	15.7	2.0	8.1	31.0	.06	.17	4000	400
8-13-68	1250	14.9	2.0	8.7	31.2	.03	.14	1000-	100
8-13-68	1555	14.8	2.0	8.8	31.1	.04	.15	4000	200
8-14-68	1125	16.0	2.0	8.3	30.9	.07	.15	3600	80
8-14-68	1355	15.3	2.0	8.9	30.9	.09	.12	600	10-
8-14-68	1650	15.8	2.0	8.9	30.7	.07	.25	230000	27000
8-15-68	1215	15.4	2.0	8.4	31.1	.04	.24	34000	4200
8-15-68	1515	14.4	2.0	8.9	31.2	.04	.12	8300	460
8-15-68	1805	14.4	2.0	9.2	31.2	.04	.15	140000	65000

TABLE B-49

SUMMARY OF FIELD DATA - STATION BH-32

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER V 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4. MG/L	COLIFORM BACTERIA MF TOTAL	COLIFORM BACTERIA MF FECAL
8-13-68	935	15.6	2.0	8.1	31.3	.06	.16	5400	800
8-13-68	1220	15.1	2.0	9.1	31.2	.04	.10	1400-	160
8-13-68	1515	14.7	2.0	8.7	31.3	.06	.17	3700	180
8-14-68	1050	16.7	2.0	8.0	30.8	.08	.15	1500	110
8-14-68	1320	15.7	2.0	8.7	30.5	.07	.11	50000+	1900
8-14-68	1610	16.0	2.0	8.9	30.8	.05	.16	200	60
8-15-68	1125	15.7	2.0	8.2	31.4	.05	.14	18000	14000
8-15-68	1430	14.2	2.0	9.0	30.6	.03	.16	31000	1100
8-15-68	1725	14.2	2.0	9.0	31.0	.04	.15	17000	1000

TABLE B-50

SUMMARY OF FIELD DATA - STATION BH-33

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER V 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4, MG/L	COLIFORM BACTERIA MF TOTAL	COLIFORM BACTERIA MF FECAL
8-13-68	930	15.3	2.0	8.3	31.0	.05	.14	100-	10-
8-13-68	1215	15.9	2.0	8.4	30.3	.03	.23	300	100
8-13-68	1510	15.4	2.0	8.9	31.0	.04	.17	10000	670
8-14-68	1045	17.0	2.0	8.5	31.0	.06	.14	10	2-
8-14-68	1310	15.5	2.0	8.5	30.4	.07	.15	1000	98
8-14-68	1605	15.6	2.0	8.8	30.7	.06	.18	100	30
8-15-68	1115	15.6	2.0	8.2	31.1	.04	.12	8700	380
8-15-68	1425	15.2	2.0	8.4	30.3	.04	.23	11000	970
8-15-68	1720	14.1	2.0	9.0	31.1	.04	.15	12000	540

TABLE B-51

SUMMARY OF FIELD DATA - STATION BH-34

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER V 1968

DATE	TIME	TEMP.	DEPTH	D.O.	SALINITY	NO3-N	TOTAL ORTHO-PHOSPHATE	COLIFORM BACTERIA MF	
		DEG.C	FT.	MG/L	PPT	MG/L	PO4, MG/L	TOTAL	FECAL
8-13-68	920	15.5	2.0	8.2	31.0	.05	.14	100	10-
8-13-68	1205	16.2	2.0	8.4	30.4	.04	.20	300	50
8-13-68	1500	16.1	2.0	8.8	31.0	.04	.14	1000	70
8-14-68	1030	16.6	2.0	8.5	31.0	.08	.14	250	60
8-14-68	1300	16.1	2.0	8.4	30.3	.06	.20	1900	88
8-14-68	1555	16.4	2.0	9.1	30.8	.08	.14	300	10-
8-15-68	1110	15.6	2.0	8.5	31.0	.03	.13	40000	2900
8-15-68	1415	15.9	2.0	8.7	30.5	.04	.17	31000	1100
8-15-68	1705	15.3	2.0	9.3	31.1		.13	4300	550

TABLE B-52

SUMMARY OF FIELD DATA - STATION bH-35

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER V 1968

DATE	TIME	TEMP.	DEPTH	D.O.	SALINITY	NO3-N	TOTAL ORTHO-PHOSPHATE	COLIFORM BACTERIA MF	
		DEG.C	FT.	MG/L	PPT	MG/L	PO4, MG/L	TOTAL	FECAL
8-13-68	851	15.2	2.0	8.2	31.0	.06	.13	100	50
8-13-68	1145	15.9	2.0	8.2	30.6	.02	.13	100	10
8-13-68	1445	15.2	2.0	8.9	30.5	.05	.14	8500	390
8-14-68	1015	16.8	2.0	8.0	30.7	.05	.12	370	78
8-14-68	1245	18.0	2.0	8.7	30.1	.08	.11	510	74
8-14-68	1540	15.6	2.0	8.5	30.5	.06	.13	4200	550
8-15-68	1050	15.8	2.0	8.4	30.6	.06	.14	5200	550
8-15-68	1400	16.2	2.0	8.7	30.6	.04	.15	26000	1200
8-15-68	1650	14.5	2.0	9.5	30.6	.03	.13	22000	610

TABLE B-53

SUMMARY OF FIELD DATA - STATION BH-36

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER V 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4, MG/L	COLIFORM BACTERIA MF TOTAL	 FECAL
8-13-68	1035	16.2	2.0	7.9	30.9	.08	.16	1400	160
8-13-68	1300	14.8	2.0	8.7	31.3	.03	.13	2400	100
8-13-68	1610	15.0	2.0	9.1	31.2	.05	.14	3000	180
8-14-68	1130	16.7	2.0	8.3	31.0	.07	.14	1800	140
8-14-68	1405	16.1	2.0	8.8	31.4	.07	.14	1900	50
8-14-68	1700	17.5	2.0	9.5	31.0	.06	.15	200	200
8-15-68	1530	14.5	2.0	9.0	31.3	.03	.11	16000	590
8-15-68	1230	16.1	2.0	8.3	31.3	.04	.14	9500	690
8-15-68	1825	14.7	2.0	9.3	31.2	.06	.16	240000	13000

TABLE B-54

SUMMARY OF FIELD DATA - STATION BH-37

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER V 1968

DATE	TIME	TEMP.	DEPTH	D.O.	SALINITY	NO3-N	TOTAL ORTHO-PHOSPHATE	COLIFORM BACTERIA MF	
		DEG.C	FT.	MG/L	PPT	MG/L	PO4. MG/L	TOTAL	FECAL
8-13-68	1025	16.2	2.0	8.0	30.9	.06	.22	230	80
8-13-68	1255	15.4	2.0	8.4	31.3	.03	.14	4400	250
8-13-68	1605	16.0	2.0	9.1	31.5	.05	.14	200	10-
8-14-68	1140	17.1	2.0	8.1	31.2	.06	.16	1600	140
8-14-68	1410	15.9	2.0	8.9	31.0	.08	.14	2300	100
8-14-68	1705	15.2	2.0	9.3	31.0	.08	.16	50000+	5000+
8-15-68	1225	16.2	2.0	8.7	31.0	.04	.14	4700	160
8-15-68	1525	16.2	2.0	9.1	31.2	.04	.25	23000	620
8-15-68	1815	15.9	2.0	9.5	31.3	.06	.15	1700	700

TABLE B-55

SUMMARY OF FIELD DATA - STATION BA

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER VI 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4. MG/L	COLIFORM BACTERIA MF TOTAL	COLIFORM BACTERIA MF FECAL
9-24-68	635	17.7	2.0	6.3		.12	.26	740	50
9-24-68	930	17.4	2.0	6.8	31.4			5600	540
9-24-68	1235	16.9	2.0	7.3	31.4	.13	.24	13600	1120
9-25-68	735	17.9	2.0	6.0	31.2	.09	.32	400	60
9-25-68	1035	17.5	2.0	6.5	30.7			13700	7400
9-25-68	1330	17.0	2.0	7.6	30.8	.06	.20	41000	4700
9-26-68	800	18.3	2.0	5.7	31.1	.29	.26	800	90
9-26-68	1100	17.3	2.0	6.0	30.8			16000	5200
9-26-68	1301	16.1	2.0	6.8	31.0	.09	.16	145000	9900

TABLE B-56

SUMMARY OF FIELD DATA - STATION BH-26

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER VI 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4. MG/L	COLIFORM BACTERIA MF TOTAL	FECAL
9-24-68	710	17.0	2.0	6.5		.19	.36	10000	7900
9-24-68	947	16.7	2.0	6.8	31.2			122000	6100
9-24-68	1250	17.2	2.0	7.3	31.1	.20	.27	380000	16000
9-25-68	755	17.8	2.0	6.3	31.0	.09	.28	23000	1500
9-25-68	1055	16.6	2.0	6.8	30.5			910000	60000
9-25-68	1350	17.5	2.0	6.8	31.1	.09	.25	3100	600
9-26-68	830	17.6	2.0	6.2	31.2	.06	.22	37000	1000
9-26-68	1115	16.8	2.0	6.3	30.8			500000	34000
9-26-68	1320	17.1	2.0	6.0	30.7	.05	.23	1100000	48000

TABLE B-57

SUMMARY OF FIELD DATA - STATION BH-27

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER VI 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4, MG/L	COLIFORM BACTERIA MF TOTAL	FECAL
9-24-68	715	16.4	2.0	7.0		.32	.22	80000	12000
9-24-68	950	16.2	2.0	7.8	31.5			42600	3000
9-24-68	1255	16.6	2.0	8.1	31.2	.16	.18	580	96
9-25-68	800	16.7	2.0	6.5	31.2	.09	.29	125000	5500
9-25-68	1100	16.3	2.0	7.3	31.1			81000	6800
9-25-68	1400	16.8	2.0	7.6	30.2	.09	.18	1500	400
9-26-68	835	16.4	2.0	6.2	31.3	.05	.20	521000	40000
9-26-68	1120	16.1	2.0	6.5	30.9			400000	30000
9-26-68	1325	16.1	2.0	7.0	31.4	.08	.16	62000	34000

TABLE B-58

SUMMARY OF FIELD DATA - STATION BH-28

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER VI 1968

DATE	TIME	TEMP.	DEPTH	D.O.	SALINITY	NO3-N	TOTAL ORTHO-PHOSPHATE	COLIFORM BACTERIA MF	
		DEG.C	FT.	MG/L	PPT	MG/L	PO4. MG/L	TOTAL	FECAL
9-24-68	720	16.4	2.0	7.0		.17	.20	15200	610
9-24-68	955	16.6	2.0	7.6	31.3			14900	560
9-24-68	1300	16.1	2.0	8.3	31.3	.19	.18	3700	200
9-25-68	810	17.1	2.0	6.5	31.1	.16	.25	14000	1200
9-25-68	1105	16.5	2.0	6.8	31.0			14700	1000
9-25-68	1405	17.4	2.0	6.8	31.0	.09	.24	400	30
9-26-68	840	17.4	2.0	6.2	31.2	.08	.22	29000	1140
9-26-68	1125	16.6	2.0	6.5	31.3			57000	3200
9-26-68	1330	15.8	2.0	7.3	31.3	.06	.14	79000	3400

TABLE B-59

SUMMARY OF FIELD DATA - STATION BH-29

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER VI 1968

DATE	TIME	TEMP.	DEPTH	D.O.	SALINITY	NO3-N	TOTAL ORTHO-PHOSPHATE	COLIFORM BACTERIA MF	
		DEG.C	FT.	MG/L	PPT	MG/L	PO4, MG/L	TOTAL	FECAL
9-24-68	725	16.5	2.0	7.3		.16	.19	5700	140
9-24-68	1000	16.8	2.0	7.0	31.1			9100	500
9-24-68	1305	17.0	2.0	7.6	31.1	.19	.22	180	4
9-25-68	815	17.0	2.0	6.2	31.2	.09	.26	13900	960
9-25-68	1115	16.7	2.0	6.8	31.0			11900	980
9-25-68	1410	17.6	2.0	6.8	31.1	.08	.20	630	78
9-26-68	845	17.1	2.0	6.2	31.0	.08	.22	17300	980
9-26-68	1128	16.5	2.0	6.5	31.0			40000	3500
9-26-68	1335	16.3	2.0	6.5	31.1	.08	.17	9200	440

TABLE B-60

SUMMARY OF FIELD DATA - STATION BH-30

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER VI 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4, MG/L	COLIFORM BACTERIA MF TOTAL	FECAL
9-24-68	730	17.3	2.0	6.5		.15	.30	22600	2160
9-24-68	1005	16.5	2.0	7.3	31.3			18800	1270
9-24-68	1310	16.5	2.0	7.8	31.3	.17	.19	550	58
9-25-68	825	17.4	2.0	6.5	31.0	.10	.28	11000	1500
9-25-68	1118	16.5	2.0	7.0	31.0			19000	1800
9-25-68	1420	16.8	2.0	7.6	31.2	.10	.18	400	20
9-26-68	850	17.1	2.0	6.5	31.4	.06	.21	3300	160
9-26-68	1132	16.6	2.0	6.5	31.0			60000	3500
9-26-68	1345	15.8	2.0	7.0	30.9	.08	.15	24000	1700

TABLE B-61

SUMMARY OF FIELD DATA - STATION BH-31

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER VI 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4. MG/L	COLIFORM BACTERIA MF TOTAL	FECAL
9-24-68	735	17.2	2.0	7.3		.12	.25	44000	2700
9-24-68	1010	16.5	2.0	7.3	31.2			49000	1400
9-24-68	1315	17.3	2.0	7.0	30.8	.19	.27	83000	3900
9-25-68	830	17.4	2.0	6.5	31.1	.11	.28	26000	2200
9-25-68	1125	16.6	2.0	6.8	31.4			15500	1400
9-25-68	1425	17.6	2.0	7.0	30.9	.09	.21	16000	860
9-26-68	900	18.2	2.0	6.0	31.1	.06	.25	13000	1700
9-26-68	1135	16.6	2.0	6.5	31.1			76000	3900
9-26-68	1350	16.0	2.0	6.8	31.0	.05	.16	72000	4500

TABLE B-62

SUMMARY OF FIELD DATA - STATION BH-32

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER VI 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4. MG/L	COLIFORM BACTERIA MF TOTAL	COLIFORM BACTERIA MF FECAL
9-24-68	703	17.1	2.0	6.3			.27	13600	1170
9-24-68	945	16.7	2.0	6.5	31.6			50000	4080
9-24-68	1247	17.0	2.0	7.6	31.1	.19	.19	14000	760
9-25-68	950	18.0	2.0	6.0	30.8	.10	.28	23000	1700
9-25-68	1050	16.5	2.0	7.3	31.1			36000	2700
9-25-68	1345	17.1	2.0	6.8	31.4	.08	.23	17000	1500
9-26-68	825	17.5	2.0	6.0	31.0	.06	.22	35000	1300
9-26-68	1110	16.5	2.0	6.5	31.0			152000	9700
9-26-68	1315	16.3	2.0	6.8	30.9	.05	.18	300000	18400

TABLE B-63

SUMMARY OF FIELD DATA - STATION BH-33

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER VI 1968

DATE	TIME	TEMP.	DEPTH	D.O.	SALINITY	NO3-N	TOTAL ORTHO-PHOSPHATE	COLIFORM BACTERIA MF	
		DEG.C	FT.	MG/L	PPT	MG/L	PO4. MG/L	TOTAL	FECAL
9-24-68	700	17.1	2.0	6.5		.10	.21	21200	1050
9-24-68	940	16.5	2.0	6.3	32.2			60000	7000
9-24-68	1245	17.1	2.0	7.3	30.7	.21	.29	12400	1460
9-25-68	745	17.3	2.0	6.3	31.2	.10	.26	10800	750
9-25-68	1046	16.7	2.0	7.0	30.8			75000	5800
9-25-68	1340	17.6	2.0	7.0	30.9	.09	.27	19000	1500
9-26-68	820	17.6	2.0	6.2	31.1	.06	.22	69000	4100
9-26-68	1107	16.7	2.0	6.5	30.8			440000	30000
9-26-68	1310	16.6	2.0	6.3	30.6	.06	.24	350000	23700

TABLE B-64

SUMMARY OF FIELD DATA - STATION BH-34

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER VI 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4. MG/L	COLIFORM BACTERIA MF TOTAL	FECAL
9-24-68	645	16.8	2.0	6.3			.21	28700	630
9-24-68	955	16.7	2.0	6.8	31.1			60000	7000
9-24-68	1240	17.2	2.0	7.0	31.2	.16	.25	30000	1910
9-25-68	740	16.9	2.0	6.2	31.1	.09	.24	24000	1900
9-25-68	1043	16.8	2.0	6.8	30.9			97000	6500
9-25-68	1335	17.5	2.0	6.8	31.1	.06	.24	17300	1800
9-26-68	815	17.5	2.0	6.0	31.2	.06	.23	56000	3400
9-26-68	1105	17.1	2.0	6.3	30.8			266000	73600
9-26-68	1305	17.2	2.0	6.5	30.8	.09	.23	144000	10200

TABLE B-65

SUMMARY OF FIELD DATA - STATION BH-35

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER VI 1968

DATE	TIME	TEMP.	DEPTH	D.O.	SALINITY	NO3-N	TOTAL ORTHO-PHOSPHATE	COLIFORM BACTERIA MF	
		DEG.C	FT.	MG/L	PPT	MG/L	PO4. MG/L	TOTAL	FECAL
9-24-68	628	17.0	2.0	7.3	31.8		.20	23400	970
9-24-68	920	17.2	2.0	6.8	30.0			10200	750
9-24-68	1230	17.1	2.0	7.3	31.1	.16	.24	40000	3830
9-25-68	725	17.0	2.0	6.2	31.3	.10	.25	21000	1800
9-25-68	1030	17.0	2.0	6.5	30.7			20000	1400
9-25-68	1325	16.9	2.0	7.0	31.0	.09	.21	73000	4300
9-26-68	755	17.3	2.0	6.2	31.0	.08	.22	35000	1200
9-26-68	1055	17.2	2.0	6.3	30.7			26000	1600
9-26-68	1300	16.2	2.0	6.5	31.2	.08	.24	300000	18300

TABLE B-66

SUMMARY OF FIELD DATA - STATION bH-36

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER VI 1968

DATE	TIME	TEMP.	DEPTH	D.O.	SALINITY	NO3-N	TOTAL ORTHO-PHOSPHATE	COLIFORM BACTERIA MF	
		DEG.C	FT.	MG/L	PPT	MG/L	PO4. MG/L	TOTAL	FECAL
9-24-68	747	17.4	2.0	6.5		.19	.25	27100	7610
9-24-68	1015	17.2	2.0	6.8	31.1			14900	1270
9-24-68	1325	16.9	2.0	7.3	31.0	.20	.22	35000	4000
9-25-68	840	17.8	2.0	6.2	31.2	.10	.29	3100	300
9-25-68	1135	16.4	2.0	7.0	31.2			63000	4000
9-25-68	1435	16.8	2.0	7.3	31.0	.08	.22	32000	3200
9-26-68	910	18.2	2.0	5.5	30.9	.09	.26	86000	5400
9-26-68	1145	16.2	2.0	6.5	31.2			102000	6700
9-26-68	1400	16.6	2.0	6.8	31.0	.09	.18	71000	3600

TABLE B-67

SUMMARY OF FIELD DATA - STATION BH-37

BOSTON HARBOR STUDY

SAMPLING PERIOD NUMBER VI 1968

DATE	TIME	TEMP. DEG.C	DEPTH FT.	D.O. MG/L	SALINITY PPT	NO3-N MG/L	TOTAL ORTHO-PHOSPHATE PO4, MG/L	COLIFORM BACTERIA MF TOTAL	COLIFORM BACTERIA MF FECAL
9-24-68	740	17.4	2.0	6.8		.13	.28	60000	1800
9-24-68	1018	16.4	2.0	7.0	31.4			60000	8000
9-24-68	1320	17.4	2.0	7.3	31.9	.09	.25	8400	620
9-25-68	835	17.7	2.0	6.2	31.0	.10	.29	41000	3400
9-25-68	1130	16.9	2.0	6.8	31.1			20000	780
9-25-68	1430	17.8	2.0	7.3	30.9	.09	.27	3000	230
9-26-68	905	17.8	2.0	6.0	30.9	.05	.29	15000	1600
9-26-68	1140	17.0	2.0	6.8	31.2			41000	3100
9-26-68	1355	16.8	2.0	6.5	31.3	.09	.21	20000	1300

APPENDIX C

TABLE C

BENTHIC ORGANISMS
PER SQ. FT.

BOSTON HARBOR - AUGUST 1968

KINDS	STATION NUMBER BH - BA	BB	BC	BD	6	8	13	16	19	22	27	37	38	39	40	41	42	43	44	45	46	47
MARINE WORMS (POLYCHAETA)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPIONIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
POLYDORA LIGNI	2159	67	90	-	18	3	66	-	31	32	-	735	223	6	-	10	-	132	11	-	383	-
UNIDENTIFIED	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
DORVILLEIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
STAURONEREIS RUDOLPHI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-
NEPHTYIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPHTYS INCISCA	-	1	-	-	3	-	-	-	-	1	-	-	1	-	-	-	-	-	1	-	-	-
NEPHTYS INGENS	-	34	-	-	40	28	3	-	-	-	-	4	4	4	-	18	56	8	-	-	-	-
NEPHTYS CAECA	-	-	1	-	-	-	-	-	-	1	45	-	-	-	-	-	-	1	-	-	-	-
PECTINARIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PECTINARIA GOULDII	-	-	-	1	-	-	-	-	-	-	-	-	1	1	-	3	-	-	-	-	-	-
CAPITELLIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CAPITELLA CAPITATA	-	-	-	-	-	-	-	-	-	7	-	-	-	-	-	-	-	-	74	-	-	-

TABLE C (CONT.)

KINDS	STATION NUMBER																					
					BH -																	
	BA	BB	BC	BD	6	8	13	16	19	22	27	37	38	39	40	41	42	43	44	45	46	47
PHYLLODOCIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHYLLODOCE FRAGILIS	-	-	-	-	-	-	-	-	-	-	-	-	13	-	-	-	-	-	-	-	-	-
PHYLLODOCE GROENLANDICA	3	43	-	3	11	1	-	1	35	14	129	-	6	109	-	4	-	-	-	-	17	4
PHYLLODOCE MUCOSA	-	-	-	-	-	-	-	-	-	-	157	-	-	-	-	-	-	-	-	-	-	-
PHYLLODOCE SP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	14
EUMIDA SANGUINEA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-
ETEONE LACTEA	-	-	6	14	24	15	-	1	25	18	55	6	-	-	-	101	77	1	-	-	-	10
PARANAITIS SPECIOSA	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CIRRATULIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
THARYX ACUTUS	-	127	3	6	217	3	7	1	20	67	-	13	78	10	24	281	238	3	1	8	546	6
CIRRATULUS GRANDIS	74	1	-	60	-	-	-	-	13	-	-	-	-	-	-	-	-	-	-	-	-	-
PARAONIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ARICIDEA JEFFREYSII	-	1	6	-	15	3	6	1	-	209	-	-	-	6	1	4	-	-	-	-	224	31
PARAONIS SP	-	-	-	20	20	7	-	-	-	1	1	-	-	-	-	1	15	-	-	-	-	8
FLABELLIGERIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHERUSA PLUMOSA	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-
SIGALIONIDAE	-	1	-	3	-	-	-	-	4	1	4	1	-	3	-	13	1	-	-	-	-	11
NEREIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEREIS VIRENS	-	1	-	1	-	-	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	3

TABLE C (CONT.)

KINDS	STATION NUMBER BH - BA	BB	BC	BD	6	8	13	16	19	22	27	37	38	39	40	41	42	43	44	45	46	47
NEREIS PELAGICA	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-
LYCASTOPSIS PONTICA	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
POLYNOIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HARMOTHOE IMBRICATA	-	4	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	0	-	-
LEPIDONOTUS SQUAMATUS	-	-	-	14	-	-	-	1	7	-	1	-	-	-	-	-	-	-	1	0	-	-
ARABELLIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ARABELLA IRICOLOR	-	-	-	1	3	6	-	3	10	65	-	-	-	-	-	-	-	-	1	-	-	-
SERPULIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPIRORBIS SPIRILLUM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-
ORBINIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ORBINIA SP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-
UNIDENTIFIED POLYCHAETES	-	-	-	-	-	-	-	1	-	-	-	3	-	-	3	-	-	-	-	-	-	-
SCUDS (AMPHIPODA)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AMPELISCIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AMPELISCA MACROCEPHALA	-	4	141	-	1445	211	14	-	1285	1567	10	-	-	1	-	45	52	59	-	-	1389	52
AMPELISCA SPINIPES	-	-	1	-	309	-	-	-	643	379	-	-	-	-	-	-	-	-	-	-	177	-
COROPHIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COROPHIUM VOLUTATOR	-	-	4	3	495	132	-	1	199	340	87	-	-	7	7	60	127	4	21	-	370	11

TABLE C (CONT.)

STATION NUMBER

KINDS	BA	BB	BC	BD	BH - 6	8	13	16	19	22	27	37	38	39	40	41	42	43	44	45	46	47
PHOTIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LEPTOCHERIUS PINGUIS	-	3	10	-	178	59	1	1	312	32	-	-	-	-	-	10	45	6	-	-	151	-
GAMMARIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GAMMARUS LOCUSTA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-
GAMMARUS ANNULATUS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-
MELITA NITIDA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-
MELITA DENTATA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-
LYSIANASSIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LYSIANOPSIS ALBA	-	-	1	10	139	21	3	-	370	241	6	-	-	-	-	4	80	-	-	-	-	-
AMPITHOIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AMPITHOE RUBRICATA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-
PONTOGENEIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PONTOGENEIA INERMIS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-
SOWBUGS (ISOPODA)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EDOTEA TRILOBA	-	-	-	-	85	-	-	-	1	-	2149	10	-	-	-	419	36	-	1	-	176	4
EDOTEA MONTOSA	-	-	-	-	-	-	-	-	-	22	-	-	-	-	-	-	-	-	-	-	-	-
IDOTEA PHOSPHOREA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-
BIVALVE (MOLLUSCA)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ENSIS DIRECTIS	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-

TABLE C (CONT.)

KINDS	STATION NUMBER BH - BA	BB	BC	BD	6	8	13	16	19	22	27	37	38	39	40	41	42	43	44	45	46	47
TELLINA AGILIS	-	6	3	-	3	-	-	-	-	-	10	-	-	-	11	3	18	1	-	-	6	6
MACOMA BALTHICA	-	-	3	4	-	20	6	-	1	-	8	-	-	-	-	-	7	-	-	-	-	-
MYTILUS EDULIS	-	-	-	-	-	-	-	13	-	-	-	-	-	-	-	-	-	-	-	0	-	13
LYONSIA HYALINA	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-
PANDORA GOULDIANA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
UNIDENTIFIED	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	0	-	-
SNAILS (GASTROPODA)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NASSARIUS SP.	-	1	1	-	-	6	-	4	8	8	55	1	1	25	1	8	6	4	-	-	11	7
POLINICES SP.	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-
PYRAMIDELLA FUSCA	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CREPIDULA FORNICATA	-	-	-	-	-	-	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
STARFISH (ASTEROIDEA)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ASTERIAS FORBESI	-	-	-	4	-	-	-	-	-	-	-	3	-	1	1	-	-	-	-	0	-	-
CUMACEAN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DIASTYLIS POLITA	-	-	-	-	-	10	-	-	-	-	57	-	-	-	-	-	36	-	-	-	-	4
UNIDENTIFIED	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	113	-	-	-	-	-	-
SHRIMP (DECAPODA)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPIRONTOCARIS PUSIOLA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-

TABLE C (CONT.)

STATION NUMBER

BH -

KINDS	BA	BB	BC	BD	6	8	13	16	19	22	27	37	38	39	40	41	42	43	44	45	46	47
CAPRELLIDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CAPRELLA LINEARIS	-	-	-	-	1	-	-	-	-	-	-	90	-	-	-	-	-	-	-	0	-	3
BRITTLE STAR (OPHIUROIDEA)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OPHIOPHOLIS ACULEATA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-
UNIDENTIFIED	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
SEA URCHIN (ECHINOIDEA)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
STRONGYLOCENTROTUS DROEBACHIENSIS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-
CHITONS (AMPHINEURA)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHAETOPLEURA APICULATA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-
COPEPOD	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
NEMATODA	-	17	-	8	32	-	11	-	1050	28	-	3	-	3	10	66	46	-	-	0	95	42
TOTAL ORGANISMS	2237	316	270	153	3040	525	118	45	4014	3058	2575	872	327	179	65	867	841	219	117	22	3945	235
TOTAL KINDS	4	17	13	16	20	15	10	14	17	21	16	14	8	13	10	20	16	10	9	22	12.	20

0=QUALITATIVE SAMPLE-GIVEN AN ARBITRARY VALUE OF 1 IN THE TOTALS

APPENDIX D

CLASSIFICATION OF PLANKTON SPECIES TAKEN IN BOSTON HARBOR IN 1968

PHYTOPLANKTON

Diatoms

- *Nitzchia sp.*
- *Chaetoceros sp.*
- *Skeletonema sp.*
- *Fragillaria sp.*
- *Pleurosigma sp.*
- *Gyrosigma sp.*
- *Melosira sp.*
- *Asterionella sp.*
- *Coscinodiscus sp.*
- Other Centric
- Other Pennate

Greens

- *Scenedesmus sp.*
- *Pediastrum sp.*

ZOOPLANKTON

Dinoflagellates

- *Ceratium sp.*
- *Peridinium sp.*
- *Dinophysis sp.*
- *Gonyaulax sp.*

Copepods
Ciliates

- *Tintinnopsis sp.*

APPENDIX E

AUG 23 1968

Lab. Water Pollution MASSACHUSETTS DEPARTMENT OF PUBLIC HEALTH Boston (City or Town)

WASTE ANALYSIS (mg. per liter) Division of Water Pollution Control

Source A Deer Island S.T.P. - Influent
Source B " " " - Effluent
Source C " " " "
Source D " " " "
Source E " " " "
Source F " " " "

	A	B	C	D	E	F
Sample No.	RW5495	496	497	519	555	563
Date of Collection	8/13	8/13	8/12-8/13	8/13-8/14	8/14-8/15	8/15-8/16
Type Sample	Grab	Grab	Comp.	Comp.	Comp.	Comp.
Time of Collection	7:30 am	7:30 am				
Collector						
Date Received	8/13	8/13	8/13	8/14	8/15	8/16
Temperature						
COD						
BOD	320	150	119	153	172	117
Suspended Total	526	54	75	97	112	92
Solids - Loss	455	50	65	83	94	76
pH	6.8	6.7	7.1	7.3	6.6	7.0
Alkalinity - phth						
Total	105	93	83	81	73	90
Coliform MPN						
Total Solids						
Loss on Ignition						
Dissolved Oxygen						
Relative Stability						
Organic N	20.4	6.2	8.7	13	10.4	8.7
Ammonia-N	8.7	9.2	6.7	5.9	5.6	7.3
Nitrite - Nitrogen	0.000	0.000	0.002	0.000	0.004	0.001
Nitrate - Nitrogen	0.0	0.0	0.0			
Total P			3.3	3.7	2.7	3.5

Remarks: Samples allegedly were collected at Deer Island, but none were so identified. Some arrived without any identification whatever.

Flow mgd 298.7 294.6 283.3 278.4

AUG 7 1968

Lab. Water Pollution **MASSACHUSETTS DEPARTMENT OF PUBLIC HEALTH** BOSTON
WASTE ANALYSIS (mg. per liter) (City or Town)
Division of Water Pollution Control

Source A	Nut Island S.T.P.	- Effluent sewage
Source B	" " "	- Digester Overflow to Sea
Source C	" " "	- Effluent Sewage
Source D	" " "	- Digester Overflow to Sea
Source E	" " "	- Effluent Sewage
Source F	" " "	- Digester Overflow to Sea

	A	B	C	D	E	F
Sample No.	[illegible]	331	332	333	377	378
Date of Collection	7-30-68		7-31		8-1	
Type Sample	Comp.	Comp.	Comp.	Comp.	Comp.	Comp.
Time of Collection						
Collector						
Date Received	7-30	7-30	7-31	7-31	8-1	8-1
Temperature						
COD						
BOD	106	2110	77	2020	77	2200
Suspended Total Solids - Loss	90 66		96 80		94 84	
pH						
Alkalinity - phth Total						
Coliform MPN						
Total Solids Loss on Ignition		18,200 10,800		15,400 9,200		14,400 8,700
Dissolved Oxygen						
Relative Stability						
Total Kj - N	[illegible]	1220	15	1120	15.5	[illegible]
Ammonia - N	10.5	717	8.9	605	9.6	604
Nitrite - Nitrogen	0.025		0.000		0.000	
Nitrate - Nitrogen	0.2		0.1		0.1	
Total P	6.3	213	6.7	220	7.7	[illegible]

Remarks:

Flow mgd	88.11	.256	96.09	.270	.88.53	.279

AUG 7 1968

Lab. Water Pollution MASSACHUSETTS DEPARTMENT OF PUBLIC HEALTH BOSTON
(City or Town)

WASTE ANALYSIS (mg. per liter)

Division of Water Pollution Control

Source A Nut Island S.T.P. - Effluent Sewage
Source B " " " - Digester Overflow to Sea
Source C
Source D
Source E
Source F

	A	B	C	D	E	F
Sample No.	RL5406	407				
Date of Collection	8-2-68					
Type Sample	Comp.	Comp.				
Time of Collection						
Collector						
Date Received	8-2	8-2				
Temperature						
COD						
BOD	113	2200				
Suspended Total Solids - Loss	96 66					
pH						
Alkalinity - phth Total						
Coliform MPN						
Total Solids Loss on Ignition		15,600 9,100				
Dissolved Oxygen						
Relative Stability						
Total Kj. - N	17.9	1060				
Ammonia N	9.5	806				
Nitrite - Nitrogen	0.000					
Nitrate - Nitrogen	0.3					
Total P	8.6	190				

Remarks: 84.94 .303

APPENDIX F

LOCAL CLIMATOLOGICAL DATA

U. S. DEPARTMENT OF COMMERCE - C. R. SMITH, Secretary
ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION — ENVIRONMENTAL DATA SERVICE

BOSTON, MASSACHUSETTS
LOGAN INTERNATIONAL AIRPORT
MAY 1968

Latitude 42° 22' N Longitude 71° 02' W Elevation (ground) 15 ft. Standard time used: EASTERN

Date	Temperature (°F) Maximum	Minimum	Average	Departure from normal	Average dew point	Degree days (Base 65°)	Weather types shown by code 1-9 on dates of occurrence	Snow, Sleet, or Ice on ground at 07AM (In.)	Precipitation Total (Water equivalent) (In.)	Snow, sleet (In.)	Avg. station pressure (In.) Elev. 29 feet m.s.l.	Wind Resultant direction	Resultant speed (m.p.h.)	Average speed (m.p.h.)	Fastest mile Speed (m.p.h.)	Fastest mile Direction	Sunshine Total (Hours and tenths)	Percent of possible	Sky cover (Tenths) Sunrise to sunset	Midnight to midnight	Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	61	44*	53	-1	40	12	8	0	T	0	29.51	27	3.9	10.9	18	SW	9.5	68	10	10	1
2	66	49	58	4	36	7		0	T	0	29.62	29	13.8	14.0	26	NW	12.2	86	7	6	2
3	63	47	55	1	42	10		0	T	0	29.60	22	9.0	12.8	18	S	12.6	89	4	6	3
4	68	51	60	5	46	5	1 8	0	.06	0	29.61	27	10.0	13.4	17	SW	7.1	50	10	8	4
5	60	47	54	-1	42	11	1	0	0	0	29.81	03	5.7	11.5	16	E	9.8	69	7	7	5
6	60	46	53	-3	33	12	1 8	0	0	0	29.98	34	10.0	14.2	19	N	1.6	11	9	8	6
7	61	45	53	-3	20	12		0	0	0	30.29	33	13.2	16.5	29	N	14.3	100	0	0	7
8	60	45	53	-3	27	12		0	0	0	30.45	15	4.3	12.1	22	SE	14.0	98	3	4	8
9	73	46	60	4	41	5		0	0	0	30.16	22	17.1	17.4	26	S	13.8	96	3	7	9
10	77*	58	68	11	48	0		0	0	0	29.92	28	10.1	14.0	24	W	9.4	38	7	7	10
11	61	51	56	-1	42	9		0	T	0	30.13	08	9.1	12.5	16	E	10.7	76	7	7	11
12	53	49	51	-6	49	14	1	0	1.13	0	29.98	04	12.2	16.0	29	NE	0.0	0	10	10	12
13	54	50	52	-6	45	13		0	0	0	30.25	07	9.2	13.2	21	NE	14.1	97	4	4	13
14	76	49	63	5	43	2		0	0	0	30.22	24	12.7	14.0	23	SW	14.4	99	1	3	14
15	72	49	61	2	43	4		0	0	0	29.95	20	7.5	11.9	17	SW	14.6	100	10	8	15
16	67	53	60	1	54	5	1 8	0	.13	0	29.70	22	10.3	11.8	17	SW	5.2	36	10	8	16
17	60	49	55	-4	51	10	1	0	.43	0	29.62	06	7.0	10.9	17	N	1.1	7	10	9	17
18	51	47	49	-11	45	16	1	0	.14	0	29.84	10	13.4	13.5	17	E	0.0	0	10	10	18
19	58	47	53	-7	47	12	1	0	.41	0	29.72	06	4.8	11.9	17	E	4.1	28	8	9	19
20	56	49	53	-7	47	12	1	0	.14	0	29.56	10	4.0	13.2	18	NW	2.8	19	9	9	20
21	67	49	58	-3	43	7	8	0	.02	0	29.71	29	10.4	11.8	17	NW	6.0	41	7	7	21
22	64	50	57	-4	48	8	1 3	0	.11	0	29.93	05	2.7	11.1	17	E	8.6	58	4	5	22
23	65	48	57	-5	49	8	1 8	0	T	0	30.06	22	3.5	11.8	18	SW	9.0	61	7	7	23
24	61	54	58	-4	50	7	1 8	0	.08	0	29.99	18	6.9	9.2	10	W	6.4	43	6	6	24
25	66	53	60	-2	36	5		0	0	0	30.03	33	15.1	15.4	26	NW	14.3	96	2	2	25
26	71	49	60	-3	36	5		0	0	0	30.04	36	7.4	16.8	38	NE	13.4	90	6	4	26
27	52	47	50	-13	40	15		0	0	0	30.21	07	11.5	13.7	19	NE	9.8	66	8	7	27
28	57	45	51	-13	42	14		0	0	0	30.23	09	8.2	11.1	14	E	12.0	80	8	8	28
29	60	51	56	-8	51	9	1	0	.61	0	30.07	11	14.3	18.1	27	SE	1.6	11	10	10	29
30	70	57	64	0	57	1	1 8	0	0	0	29.82	19	6.5	12.2	17	E	9.8	65	5	5	30
31	59	54	57	-8	53	8	2 8	0	T	0	29.76	09	2.1	9.9	14	E	2.1	14	9	9	31

Maximum	Minimum	Average	Departure	Average dew point
Sum	Sum	—	—	—
1949	1520	—	—	—
Avg.	Avg.	Avg.	Dep.	Avg.
62.9	49.0	56.0	-2.7	43

Degree days Total	Dep.
270	62
Season to date Total	Dep.
5980	382

Temperature: Number of days Max ≤ 32°	Max ≥ 90° §	Min ≤ 32°	Min ≤ 0°
0	0	0	0

Precipitation Total	Snow, sleet Total
3.26	0
Dep.	—
-0.08	—

For the month: Avg. station pressure	Resultant direction	Resultant speed	Average speed	Fastest mile Speed	Direction	Sunshine Total	% of possible for month	Sky cover Sum	Sum
29.93	34	.6	13.1	38	NE	280.3		212	210
—	—	—	—	Date: 26		Possible		Avg.	Avg.
—	—	—	—	—	—	432.7	57	6.8	6.8

Greatest in 24 hours and dates Precipitation		Snow, Sleet		Greatest depth on ground of snow, sleet or ice and date	
1.13	12	0		0	

* Extreme for the month. May be the last of more than one occurrence

- Below zero temperatures or negative departure from normal

T In columns 9, 10, and 11 and in the Hourly Precipitation table indicates an amount too small to measure

‡ Heavy fog — visibility ¼ mile or less

§ ≤ 70° at Alaskan stations

+ Also on an earlier date, or dates.

HOURLY PRECIPITATION (Liquid in Inches)

Date	A. M. Hour ending at 1	2	3	4	5	6	7	8	9	10	11	12	P. M. Hour ending at 1	2	3	4	5	6	7	8	9	10	11	12	Date
1														T	T		T								1
2														T	T										2
3				T	T															T	T	T	T	T	3
4	.01	.05	T	T	T	T																			4
5																									5
6																									6
7																									7
8																									8
9																									9
10																									10
11																							T	T	11
12	.04	.03	.04	.08	.12	.25	.15	.18	.05	.06	.01	.02	.01	.01	.04	.01	.02	.01	T						12
13																									13
14																									14
15																									15
16																				.01	.06	.03	T	.03	16
17	.21	.21	.01	T			T	T	T																17
18															T	T	T	.01	T	.01	.02	T	.03	.07	18
19	.13	.24	.04	T																					19
20	T	T	.02	.01	.01	.03	T	T	T	.02	.03		T		.01	T			T	.01	T				20
21																		.02	T						21
22															T	.09	.02	T			T				22
23																								T	23
24	T	T	.02	.01	.02	.02	.01	T	T	T	T														24
25																									25
26																									26
27																									27
28																									28
29											T	T	.04	.03	.02	.01	.04	.01	.34	.11	.01	T		T	29
30																									30
31						T	T	T																	31

Data in columns 6, 12, 13, 14, and 15 are based on 8 observations per day at 3-hour intervals. Wind directions are those from which the wind blows. Resultant wind is the vector sum of wind directions and speeds divided by the number of observations. Figures for directions are tens of degrees from true North; i.e., 09 = East, 18 = South, 27 = West, 36 = North, and 00 = Calm. When directions are in tens of degrees in Col. 17, entries in Col. 16 are fastest observed 1-minute speeds. If the ? appears in Col. 17, speeds are gusts. Any errors detected will be corrected and changes in summary data will be annotated in the annual Summary if published.

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I certify that this is an official publication of the Environmental Science Services Administration, and is compiled from records on file at the National Weather Records Center, Asheville, North Carolina. 28801.

William H. Haggard
Director, National Weather Records Center

AVERAGES BY HOURS

Hour (Local time)	Sky cover (tenths)	Station pressure (in.)	Temperature Dry bulb (°F)	Wet bulb (°F)	Relative humidity (%)	Dew point (°F)	Wind speed (m.p.h.)	Resultant wind Direction	Speed (m.p.h.)
01	7	29.93	52	48	73	43	11.7	29	5.1
04	6	29.92	51	47	77	43	12.1	29	4.4
07	6	29.95	53	48	73	44	12.4	32	3.5
10	7	29.96	58	51	63	43	13.0	04	1.9
13	7	29.92	60	52	59	44	15.1	09	5.5
16	7	29.90	60	52	59	43	15.9	10	4.0
19	8	29.93	57	50	65	43	12.8	17	2.1
22	7	29.95	54	49	71	44	12.1	26	1.7

USCOMM - ESSA - ASHEVILLE 900

LOCAL CLIMATOLOGICAL DATA

U. S. DEPARTMENT OF COMMERCE - C. R. SMITH, Secretary
ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION — ENVIRONMENTAL DATA SERVICE

BOSTON, MASSACHUSETTS
LOGAN INTERNATIONAL AIRPORT
JUNE 1968

Latitude 42° 22' N Longitude 71° 02' W Elevation (ground) 15 ft. Standard time used: EASTERN

Date	Temperature (°F) Maximum	Minimum	Average	Departure from normal	Average dew point	Degree days (Base 65°)	Weather types shown by code 1-9 on dates of occurrence 1 2 3 4 5 6 7 8 9	Snow, Sleet, or Ice on ground at 07AM (In.)	Precipitation Total (Water equivalent) (In.)	Snow, sleet (In.)	Avg. station pressure (In.) Elev. 29 feet m.s.l.	Wind Resultant direction	Resultant speed (m.p.h.)	Average speed (m.p.h.)	Fastest mile Speed (m.p.h.)	Direction	Sunshine Total (Hours and tenths)	Percent of possible	Sky cover (Tenths) Sunrise to sunset	Midnight to midnight	Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	63	55	59	-6	55	6	1 8	0	0	0	29.97	11	4.9	11.7	14	SE	12.8	85	3	5	1
2	61	57	59	-6	55	6	1 8	0	.27	0	29.92	19	10.4	11.5	21	S	0.3	2	10	10	2
3	69	58	64	-2	57	1	1 3 8	0	.03	0	29.77	18	1.2	11.4	34	SW	3.9	26	10	10	3
4	61	56	59	-7	56	6	1 3 8	0	.15	0	29.83	07	1.8	10.1	15	E	4.9	33	9	7	4
5	82	56	69	3	55	0	1 8	0	0	0	29.92	27	11.0	11.4	16	W	15.1	99	3	2	5
6	91	66	79	13	61	0	8	0	0	0	29.83	26	7.0	10.9	17	SW	13.6	90	3	3	6
7	77	60	69	2	55	0		0	0	0	29.90	06	9.2	9.9	16	NE	13.9	91	5	5	7
8	64	59	62	-5	53	3		0	0	0	30.04	09	8.5	11.2	14	E	14.9	98	2	3	8
9	80	56	68	1	57	0	3 8	0	.35	0	29.92	07	5.8	13.7	26	E	10.8	71	5	5	9
10	57	50*	54	-13	52	11	1	0	.39	0	30.08	08	14.2	14.7	20	E	0.0	0	10	10	10
11	55	51	53	-14	52	12	2	0	.12	0	30.06	08	9.1	9.9	12	NE	0.0	0	10	10	11
12	74	55	65	-3	63	0	1	0	.44	0	29.84	20	8.7	11.1	23	S	0.9	6	10	10	12
13	69	64	67	-1	63	0	2 8	0	.18	0	29.68	15	2.5	8.3	13	NW	5.1	33	9	9	13
14	67	61	64	-4	60	1	1 8	0	.26	0	29.90	07	5.7	10.2	14	NW	9.3	61	5	5	14
15	83	61	72	4	61	0	1 8	0	0	0	30.00	20	8.5	10.6	18	S	13.8	91	1	3	15
16	74	62	68	0	60	0	8	0	.24	0	30.04	07	4.7	11.5	15	E	7.8	51	9	9	16
17	62	57	60	-9	57	5	1	0	.11	0	30.01	04	12.5	12.9	22	NE	0.0	0	10	10	17
18	69	57	63	-6	57	2	1	0	T	0	30.08	07	2.4	10.6	18	E	12.5	82	4	5	18
19	75	60	68	-1	57	0	1 8	0	.26	0	30.02	20	14.7	15.1	22	S	11.3	74	7	8	19
20	68	57	63	-6	50	2		0	.10	0	29.76	28	13.8	15.7	26	NW	12.8	84	4	5	20
21	75	54	65	-4	45	0		0	0	0	29.87	29	13.2	14.2	29	NW	13.4	88	4	3	21
22	80	61	71	2	57	0	8	0	T	0	29.89	23	12.0	13.1	23	S	9.8	64	8	7	22
23	75	63	69	-1	57	0	8	0	0	0	29.93	31	7.1	11.2	16	N	10.7	70	8	6	23
24	78	60	69	-1	58	0	8	0	0	0	29.96	21	7.1	10.1	19	SW	7.2	47	9	8	24
25	80	65	73	3	63	0	1 8	0	.09	0	29.79	30	1.4	11.1	15	SW	5.2	34	10	10	25
26	65	57	61	-9	58	4	1 8	0	1.29	0	29.78	06	14.9	15.2	21	NE	0.0	0	10	10	26
27	58	56	57	-13	55	8	1	0	.08	0	30.00	06	13.6	14.0	25	E	0.1	1	10	10	27
28	57	54	56	-14	55	9	1 3	0	1.29	0	29.93	05	12.1	14.5	26	NE	0.0	0	10	10	28
29	78	54	66	-4	57	0	8	0	T	0	29.94	25	10.7	12.4	22	SW	12.5	82	4	6	29
30	91*	70	81	10	65	0		0	T	0	29.88	27	14.6	15.7	25	W	14.4	94	3	5	30

Sum	Sum	—	—	—	Total	Dep.	Temperature: Number of days		
2138	1752	—	—	—	76	40			
Avg.	Avg.	Avg.	Dep.	Avg.	Season to date		Max ≤ 32	Max ≥ 90°#	Min ≤ 32°	Min ≤ 0°
71.3	58.4	64.9	-2.9	57	Total	Dep.				
					6056	422	0	2	0	0

Total	Total	For the month:						Total	% for month	Sum	Sum
5.69	0	29.92	13	.3	12.1	34	SW	237.0		205	209
Dep.	—	—	—	—	—	Date: 03		Possible		Avg.	Avg.
2.17	—	—	—	—	—	—		456.8	52	6.8	7.0

Greatest in 24 hours and dates: Precipitation		Snow, Sleet		Greatest depth on ground of snow, sleet or ice and date	
1.34	25-26	0		0	

* Extreme for the month. May be the last of more than one occurrence

\- Below zero temperatures or negative departure from normal

T In columns 9, 10, and 11 and in the Hourly Precipitation table indicates an amount too small to measure

X Heavy fog — visibility ¼ mile or less

# ≦ 70° at Alaskan stations

+ Also on an earlier date, or dates

HOURLY PRECIPITATION (Liquid in Inches)

Date	A.M. Hour ending at 1	2	3	4	5	6	7	8	9	10	11	12	P.M. Hour ending at 1	2	3	4	5	6	7	8	9	10	11	12	Date
1																									1
2								T	T	T	.01	.04	.04	.08	.08	.01	T	T	.01	T	T	T			2
3																		.01	.02	T	T				3
4								T				T	.11	.03	.01										4
5																									5
6																									6
7																									7
8																									8
9																					.33	.02			9
10		T	T	.02	T	T	T	T	T	.03	.08	.01		T	T	T	T	T	.04	.06	.06	.03	.09	.01	10
11	.01	.04	.01	.01	T	T	T	T	.02	.01	T	T	T	T	T	T	T	.01	.01	T	T	T	T	T	11
12	T	T	T	T								T	.18	.17	.06	T	T	T				T	T	.03	12
13	.01	T			.01	.03	.05	.01	.05	.01											T	T	T	.01	13
14	T	T				.16	.10				T														14
15																									15
16													T				T	T	T	.01	T	.01	.03	.19	16
17	T	T	T	T	.06	T	T	T	T	T	T	T	T	T	T	T	.01	T	T		T	.04	T	T	17
18	T	T	T																						18
19																				T	.02	.13	.04	.07	19
20	.07	.03	T																						20
21																									21
22						T	T	T	T	T															22
23																									23
24																									24
25																	.04	T	T	T	T	.02	.01	.02	25
26	.03	.02	.13	.05	.06	.11	.12	.03	.06	.29	.07	.01	.16	.08	.01	.05	.01	.03	.02	T	T	T			26
27								T	.05	.01		T	T	T					T	T	T	T	T	.02	27
28	.11	.02	.48	.01	.02	.03	.02	.03	.01	.13	.02	.01		T	.10	.10	.09	.15	T	T	T		T	T	28
29																						T	T	T	29
30	T																								30

Data in columns 6, 12, 13, 14, and 15 are based on 8 observations per day at 3-hour intervals. Wind directions are those from which the wind blows. Resultant wind is the vector sum of wind directions and speeds divided by the number of observations. Figures for directions are tens of degrees from true North, i.e., 09 = East, 18 = South, 27 = West, 36 = North, and 00 = Calm. When directions are in tens of degrees in Col. 17, entries in Col. 16 are fastest observed 1-minute speeds. If the / appears in Col. 17, speeds are gusts. Any errors detected will be corrected and changes in summary data will be annotated in the annual Summary if published.

AVERAGES BY HOURS

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Resultant wind [illegible]	[illegible]
01	7	29.91	61	58	85	56	10.7	29	2.9
04	8	29.91	60	58	86	56	10.2	29	2.3
07	6	29.94	62	59	83	56	12.0	33	2.9
10	7	29.94	67	61	74	57	12.9	09	1.7
13	8	29.91	68	61	72	57	14.5	09	4.0
16	7	29.90	68	61	71	57	13.6	13	2.7
19	7	29.91	65	60	78	57	12.3	13	2.7
22	7	29.92	63	60	82	57	10.9	22	2.8

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I certify that this is an official publication of the Environmental Science Services Administration, and is compiled from records on file at the National Weather Records Center, Asheville, North Carolina 28801.

William H. Haggard
Director, National Weather Records Center

USCOMM—ESSA—ASHEVILLE 400

LOCAL CLIMATOLOGICAL DATA

U. S. DEPARTMENT OF COMMERCE - C. R. SMITH, Secretary

ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION -- ENVIRONMENTAL DATA SERVICE

BOSTON, MASSACHUSETTS
LOGAN INTERNATIONAL AIRPORT
JULY 1968

Latitude 42° 22' N Longitude 71° 02' W Elevation (ground) 15 ft. Standard time used: EASTERN

Date	Temperature (°F) Maximum	Minimum	Average	Departure from normal	Average dew point	Degree days (Base 65°)	Weather types shown by code 1-9 on dates of occurrence 1 2 3 4 5 6 7 8 9	Snow, Sleet, or Ice on ground at 07AM (In.)	Precipitation Total (Water equivalent) (In.)	Snow, sleet (In.)	Avg. station pressure (In.) Elev. 29 feet m.s.l.	Wind Resultant direction	Resultant speed (m.p.h.)	Average speed (m.p.h.)	Fastest mile Speed (m.p.h.)	Direction	Sunshine Total (Hours and tenths)	Percent of possible	Sky cover (Tenths) Sunrise to sunset	Midnight to midnight	Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	96	72	84	13	70	0	3 8	0	.01	0	29.86	27	9.3	11.9	23	N	14.1	93	1	3	1
2	92	73	83	12	64	0	8	0	0	0	29.91	25	12.8	13.7	19	W	14.6	96	7	7	2
3	79	67	73	1	57	0		0	T	0	30.06	29	5.4	9.4	17	NW	3.8	25	10	10	3
4	70	66	68	-4	61	0	8	0	T	0	30.14	20	9.7	10.2	16	S	1.7	11	10	10	4
5	80	62	71	-1	56	0	1 8	0	0	0	30.14	23	10.5	11.4	16	SW	13.7	90	1	2	5
6	82	62	72	0	59	0	1 8	0	T	0	30.08	22	6.3	10.2	18	NW	10.9	72	6	6	6
7	82	61	72	0	52	0		0	0	0	30.10	28	10.9	12.1	17	SW	14.8	97	1	1	7
8	89	65	77	4	58	0		0	0	0	30.12	24	12.4	13.8	18	SW	14.8	97	8	3	8
9	89	68	79	6	63	0	8	0	0	0	30.08	22	13.6	14.4	23	S	13.7	90	5	6	9
10	86	66	76	3	65	0	1 8	0	.30	0	30.05	21	7.3	12.4	18	SW	7.9	52	9	9	10
11	69	59	64	-9	60	1	2 8	0	0	0	30.14	07	9.1	11.2	15	NE	4.2	28	10	9	11
12	80	58*	69	-5	63	0	2 8	0	0	0	30.05	16	6.4	8.6	16	SE	8.8	59	6	5	12
13	78	66	72	-2	63	0	8	0	0	0	30.09	11	6.3	9.8	16	E	13.3	89	4	3	13
14	82	64	73	-1	63	0	1 3 8	0	0	0	30.15	14	5.9	10.1	13	SW	10.1	67	8	7	14
15	95	70	82	8	69	0	8	0	0	0	30.07	24	13.0	13.1	17	SW	13.3	89	6	5	15
16	98*	74	86	12	70	0	8	0	0	0	29.91	28	12.8	13.5	17	W	13.9	93	1	2	16
17	87	70	79	6	69	0	3 8	0	.11	0	29.97	04	8.5	11.4	17	NE	10.7	72	3	4	17
18	89	68	79	6	68	0	8	0	0	0	30.01	15	3.6	10.6	16	S	14.1	95	4	4	18
19	89	74	82	7	70	0	8	0	T	0	29.88	21	13.5	14.5	24	SW	9.3	63	7	7	19
20	80	69	75	0	61	0		0	0	0	29.95	34	5.1	11.7	15	NW	7.8	52	5	4	20
21	80	64	72	-3	55	0		0	0	0	30.09	08	.4	9.4	14	SE	11.9	80	2	2	21
22	91	69	80	5	61	0		0	0	0	30.11	22	11.9	12.5	22	SW	14.4	98	1	1	22
23	92	71	82	7	63	0	8	0	0	0	30.02	23	8.4	10.9	17	W	12.6	85	3	4	23
24	76	68	72	-3	62	0	1 8	0	.13	0	30.01	11	6.3	8.3	12	E	4.7	32	9	8	24
25	89	72	81	6	62	0	1 8	0	0	0	29.90	30	11.8	14.4	17	NW	10.5	71	7	7	25
26	78	67	73	-2	54	0		0	0	0	30.09	15	2.0	12.1	17	SE	14.7	100	1	1	26
27	84	65	75	-1	58	0		0	0	0	30.04	23	14.7	15.1	21	SW	8.8	60	10	9	27
28	85	68	77	1	59	0	8	0	0	0	29.78	24	13.7	16.5	23	NW	5.3	36	7	7	28
29	78	63	71	-5	44	0		0	0	0	29.94	29	16.3	16.7	24	NW	14.6	100	0	0	29
30	78	60	69	-6	47	0		0	0	0	30.24	28	2.7	10.8	13	NW	14.4	99	2	2	30
31	80	61	71	-4	57	0		0	0	0	30.21	19	11.1	12.1	20	SW	11.7	81	7	7	31

Sum	Sum				Total	Dep.	Temperature: Number of days				Total	Total	For the month:						Total	% for month	Sum	Sum
2601	2062	—	—	—	1	1					.55	0	30.04	24	3.4	12.0	24	NW	339.1		189	197
Avg.	Avg.	Avg.	Dep.	Avg.	Season to date		Max. ≤ 32°	Max. ≥ 90° ‡	Min. ≤ 32°	Min. ≤ 0°	Dep.	—	—	—	—	—	Date: 29+		Possible		Avg.	Avg.
83.9	66.5	75.2	1.5	61	Total	Dep.					-2.33	—	—	—	—	—	—		462.7	73	6.1	6.1
					1	1	0	6	0	0												

Greatest in 24 hours and dates Precipitation		Snow, Sleet		Greatest depth on ground of snow, sleet or ice and date	
.30	10	0		0	

* Extreme for the month. May be the last of more than one occurrence.

- Below zero temperatures or negative departure from normal.

T In columns 9, 10, and 11 and in the Hourly Precipitation table indicates an amount too small to measure.

X Heavy fog — visibility ¼ mile or less.

‡ ≥ 70° at Alaskan stations. + Also on an earlier date, or dates.

HOURLY PRECIPITATION (Liquid in Inches)

Date	A. M. Hour ending at 1	2	3	4	5	6	7	8	9	10	11	12	P. M. Hour ending at 1	2	3	4	5	6	7	8	9	10	11	12	Date
1																						T	.01		1
2																									2
3				T	T		T	T	T	T	T	T													3
4				T	T		T																		4
5																									5
6																				T					6
7																									7
8																									8
9																									9
10																T		.28	.02	T					10
11																									11
12																									12
13																									13
14																									14
15																									15
16																									16
17																			.05	.05	.01	T			17
18																									18
19																			T	T					19
20																									20
21																									21
22																									22
23																									23
24														T	T	.11	.01	T	T	.01	T				24
25																									25
26																									26
27																									27
28																									28
29																									29
30																									30
31																									31

Data in columns 6, 12, 13, 14, and 15 are based on 8 observations per day at 3-hour intervals. Wind directions are those from which the wind blows. Resultant wind is the vector sum of wind directions and speeds divided by the number of observations. Figures for directions are tens of degrees from true North, i.e., 09 = East, 18 = South, 27 = West, 36 = North, and 00 = Calm. When directions are in tens of degrees in Col. 17, entries in Col. 16 are fastest observed 1-minute speeds. If the / appears in Col. 17, speeds are gusts. Any errors detected will be corrected and changes in summary data will be annotated in the annual Summary if published.

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I certify that this is an official publication of the Environmental Science Services Administration, and is compiled from records on file at the National Weather Records Center, Asheville, North Carolina 28801.

William H. Haggard

Director, National Weather Records Center

AVERAGES BY HOURS

Hour (Local time)	Sky cover (In tenths)	Station press. (In.)	Dry bulb (°F)	Wet bulb (°F)	Rel. hum. %	Dew point (°F)	Wind speed (m.p.h.)	Resultant wind Direction	Speed (m.p.h.)
01	5	30.04	70	65	74	61	10.6	25	6.0
04	5	30.04	68	64	78	61	10.5	26	6.2
07	6	30.06	71	65	73	61	10.9	26	5.7
10	5	30.06	78	67	58	61	12.6	22	4.3
13	5	30.03	81	68	51	60	13.7	23	5.0
16	4	30.01	81	68	52	60	13.5	20	5.6
19	4	30.02	77	67	61	62	12.8	22	6.4
22	5	30.04	72	65	68	60	11.6	25	7.1

USCOMM - ESSA ASHEVILLE 900

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ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION -- ENVIRONMENTAL DATA SERVICE

BOSTON, MASSACHUSETTS
LOGAN INTERNATIONAL AIRPORT
AUGUST 1968

Latitude 42° 22′ N Longitude 71° 02′ W Elevation (ground) 15 ft. Standard time used: EASTERN

Date	Temperature (°F) Maximum	Minimum	Average	Departure from normal	Average dew point	Degree days (Base 65°)	Weather types shown by code 1-9 on dates of occurrence (1 Fog, 2 Heavy Fog X, 3 Thunderstorm, 4 Sleet, 5 Hail, 6 Glaze, 7 Duststorm, 8 Smoke, Haze, 9 Blowing Snow)	Snow, Sleet, or Ice on ground at 07AM (In.)	Precipitation Total (Water equivalent) (In.)	Snow, sleet (In.)	Avg. station pressure (In.) Elev. 29 feet m.s.l.	Wind Resultant direction	Resultant speed (m.p.h.)	Average speed (m.p.h.)	Fastest mile Speed (m.p.h.)	Direction	Sunshine Total (Hours and tenths)	Percent of possible	Sky cover (Tenths) Sunrise to sunset	Midnight to midnight	Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	83	66	77	2	65	0	1 8	0	T	0	29.96	25	12.1	13.4	21	SW	2.3	16	9	10	1
2	74	64	69	-6	64	0	1 3 8	0	.62	0	30.06	09	4.2	10.4	17	NW	4.7	33	8	8	2
3	86	65	76	1	67	0	1 8	0	0	0	30.12	19	7.7	9.9	15	SW	10.6	73	3	3	3
4	90	69	80	5	68	0	1 8	0	0	0	30.03	27	6.4	10.9	13	W	7.3	51	7	7	4
5	76	62	69	-6	60	0	8	0	0	0	30.18	06	9.5	12.9	18	NE	14.1	99	2	4	5
6	79	60	70	-5	61	0	1 8	0	.03	0	30.09	19	8.2	10.1	16	S	6.8	47	9	9	6
7	86	66	76	1	68	0	1 8	0	.74	0	29.86	20	2.[illegible]	8.9	15	E	5.7	40	9	8	7
8	77	67	72	-2	62	0	1 8	0	0	0	29.95	10	2.2	11.1	13	SW	12.3	86	2	3	8
9	79	67	73	-1	65	0	1 3 8	0	.05	0	29.87	29	.9	11.2	19	NW	4.2	30	9	8	9
10	78	66	72	-2	63	0	1 8	0	.04	0	29.72	01	2.2	11.5	16	SW	7.1	50	9	9	10
11	74	60	67	-6	46	0		0	0	0	29.83	32	11.3	14.2	25	NW	14.1	100	0	0	11
12	77	60	69	-4	49	0		0	0	0	29.97	26	11.0	11.8	17	SW	14.0	100	2	1	12
13	80	62	71	-2	57	0		0	T	0	29.99	23	11.4	12.5	21	SW	11.2	80	9	8	13
14	86	66	76	3	65	0	8	0	0	0	29.87	23	14.5	15.0	23	SW	12.1	87	3	3	14
15	79	66	73	0	44	0		0	0	0	29.96	31	13.9	14.4	21	NW	13.9	100	1	1	15
16	71	60	66	-6	52	0		0	T	0	30.02	21	2.6	11.4	16	SW	9.9	72	8	8	16
17	86	63	75	3	66	0	1 8	0	.09	0	29.77	24	3.0	8.5	16	W	6.7	49	8	7	17
18	75	62	69	-2	53	0		0	0	0	29.99	04	2.5	11.1	[illegible]	NW	13.8	100	2	1	18
19	67	57	62	-9	50	3		0	.05	0	30.14	08	4.5	9.8	13	E	11.8	86	7	6	19
20	82	65	74	3	60	0	3 8	0	.01	0	29.97	22	13.1	14.7	24	SW	2.7	20	10	10	20
21	87	71	79	8	59	0		0	0	0	29.84	31	14.0	16.1	30	NW	13.3	97	2	4	21
22	71	62	67	-3	53	0		0	T	0	30.02	07	4.5	9.2	16	SE	9.4	69	8	7	22
23	68	64	66	-4	57	0		0	T	0	30.03	07	6.8	10.4	15	NE	5.8	43	8	8	23
24	76	65	71	1	65	0	1 8	0	T	0	29.99	22	9.7	10.4	13	SW	0.6	5	10	10	24
25	93*	71	82	12	70	0	1 8	0	T	0	29.77	23	13.1	15.2	24	SW	10.4	77	6	6	25
26	81	66	74	5	57	0		0	0	0	29.80	30	13.0	13.8	24	NW	11.7	87	2	3	26
27	74	61	68	-1	46	0		0	0	0	30.00	33	12.0	13.2	18	NW	12.9	96	4	4	27
28	71	58	65	-4	48	0		0	0	0	30.18	35	4.4	11.5	17	NW	11.5	87	8	7	28
29	66	58	62	-6	49	3		0	0	0	30.24	04	7.3	10.9	14	E	9.8	74	6	6	29
30	66	57*	62	-6	53	3		0	0	0	30.17	06	3.1	10.8	17	E	11.2	84	3	1	30
31	79	58	69	1	51	0		0	0	0	30.12	24	9.0	11.4	17	SW	13.1	99	4	2	31
	Sum	Sum				Total	Dep.	Temperature: Number of days	Total	Total	For the month:						Total	% for month	Sum	Sum	
	2419	1966				9	0		1.63	0	29.98	26	3.1	11.8	30	NW	295.0		178	172	
	Avg.	Avg.	Avg.	Dep.	Avg.	Season to date Total	Dep.	Max ≤ 32° / Max ≥ 90°‡ / Min ≤ 32° / Min ≤ 0°	Dep.						Date: 21		Possible		Avg.	Avg.	
	78.0	63.4	70.7	-1.0	58	10	1	0 / 2 / 0 / 0	-2.03								429.6	69	5.7	5.5	

Greatest in 24 hours and dates				Greatest depth on ground of snow, sleet or ice and date	
Precipitation		Snow, Sleet			
.77	6- 7	0		0	

- * Extreme for the month. May be the last of more than one occurrence
- - Below zero temperatures or negative departure from normal
- T In columns 9, 10, and 11 and in the Hourly Precipitation table indicates an amount too small to measure
- X Heavy fog — visibility ¼ mile or less

‡ ≥ 70° at Alaskan stations. + Also on an earlier date, or dates

HOURLY PRECIPITATION (Liquid in Inches)

Date	A.M. Hour ending at 1	2	3	4	5	6	7	8	9	10	11	12	P.M. Hour ending at 1	2	3	4	5	6	7	8	9	10	11	12	Date
1																		T	T	T	T	T			1
2		.17	.03	.05	.15	.16	.05	.01	T					T	T										2
3																									3
4																									4
5																									5
6														T	T			.02	.01						6
7													T	.46	.20	.08									7
8																									8
9										T							.03	.02							9
10																	T		T	.04	T				10
11																									11
12																									12
13																							T		13
14																									14
15																									15
16																			T	T		T	T	T	16
17	T	T	.06	.01								T	T	.01	.01										17
18																									18
19																						.01	.04	T	19
20	T	T	T	.01															T	T					20
21																									21
22																			T	T	T	T	T	T	22
23	T			T																					23
24																						T	T	T	24
25	T			T																					25
26																									26
27																									27
28																									28
29																									29
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31																									31

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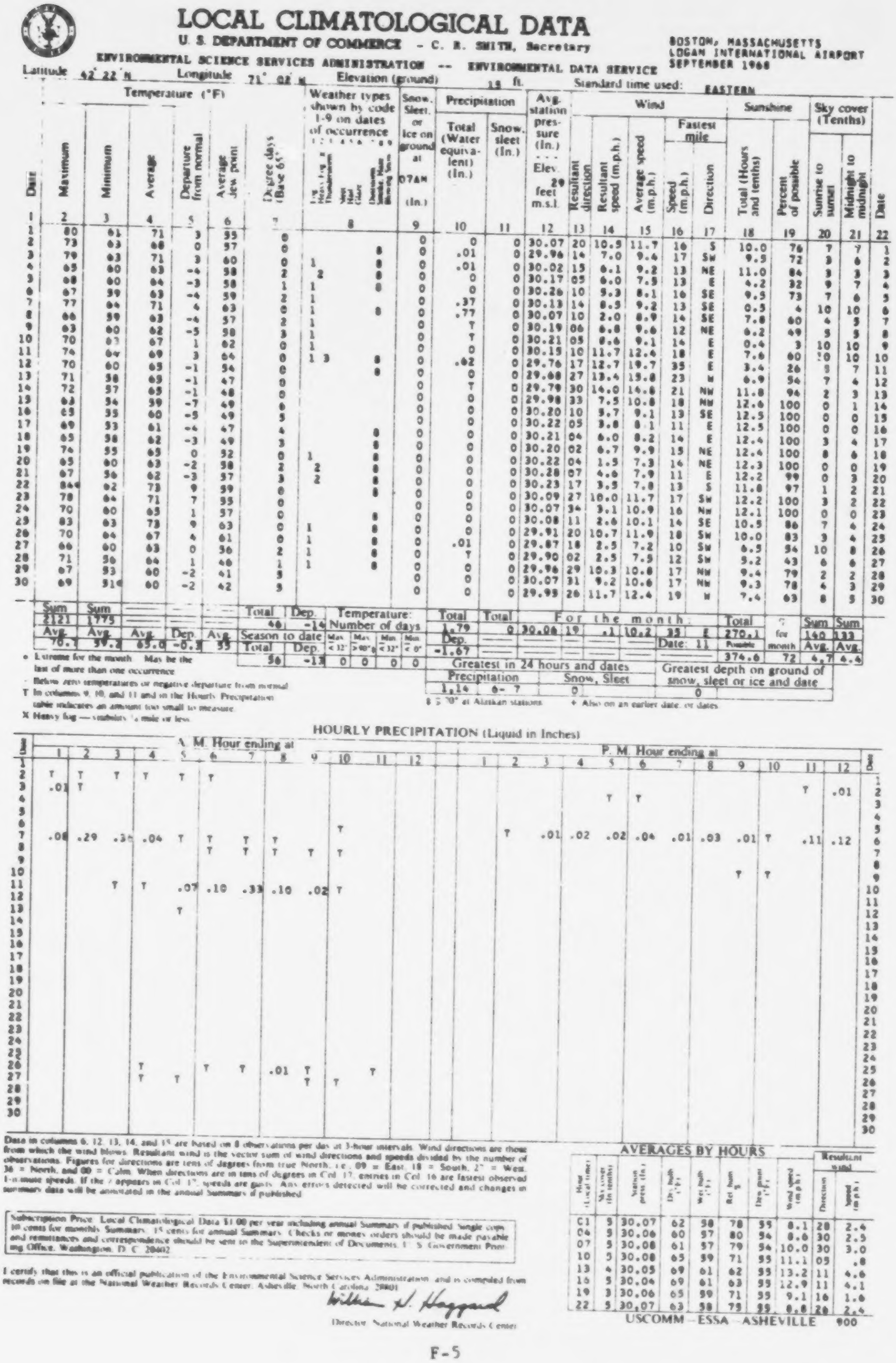
I certify that this is an official publication of the Environmental Science Services Administration, and is compiled from records on file at the National Weather Records Center, Asheville, North Carolina 28801.

William H. Haggard
Director, National Weather Records Center

AVERAGES BY HOURS

Hour (Local time)	Sky cover (In tenths)	Station press. (In.)	Dry bulb (°F)	Wet bulb (°F)	Rel. hum. (%)	Dew point (°F)	Wind speed (m.p.h.)	Resultant wind Direction	Speed (m.p.h.)
01	5	29.98	68	63	75	59	10.9	28	6.2
04	5	29.98	66	61	76	57	10.8	29	6.0
07	5	30.01	66	61	72	57	12.1	31	6.6
10	5	30.01	72	63	61	57	11.8	26	1.6
13	7	29.98	76	64	54	57	13.7	16	2.2
16	6	29.96	75	64	58	57	13.5	17	2.9
19	6	29.96	72	64	66	59	11.2	22	3.6
22	6	29.98	69	64	74	60	10.6	25	5.3

USCOMM—ESSA—ASHEVILLE 900



LOCAL CLIMATOLOGICAL DATA

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BOSTON, MASSACHUSETTS
LOGAN INTERNATIONAL AIRPORT
SEPTEMBER 1968

Latitude 42° 22' N Longitude 71° 02' W Elevation (ground) 15 ft. Standard time used: EASTERN

Date	Temperature (°F) Maximum	Temperature (°F) Minimum	Temperature (°F) Average	Departure from normal	Average dew point	Degree days (Base 65°)	Weather types shown by code 1-9 on dates of occurrence	Snow, Sleet, or Ice on ground at 07AM (In.)	Precipitation Total (Water equivalent) (In.)	Precipitation Snow, sleet (In.)	Avg. station pressure (In.) Elev. 29 feet m.s.l.	Wind Resultant direction	Wind Resultant speed (m.p.h.)	Wind Average speed (m.p.h.)	Fastest mile Speed (m.p.h.)	Fastest mile Direction	Sunshine Total (Hours and tenths)	Sunshine Percent of possible	Sky cover (Tenths) Sunrise to sunset	Sky cover (Tenths) Midnight to midnight	Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	80	61	71	3	55	0		0	0	0	30.07	20	10.5	11.7	16	S	10.0	76	7	7	1
2	73	63	68	0	57	0	8	0	.01	0	29.96	14	7.0	9.4	17	SW	9.5	72	3	6	2
3	79	63	71	3	60	0	1 8	0	.01	0	30.02	15	6.1	9.2	13	NE	11.0	84	3	3	3
4	65	60	63	-4	58	2	2 8	0	0	0	30.17	05	6.0	7.5	13	E	4.2	32	9	7	4
5	68	60	64	-3	58	1	1 8	0	0	0	30.26	10	5.3	8.1	16	SE	9.5	73	7	6	5
6	67	59	63	-4	59	2	1	0	.37	0	30.13	14	8.5	9.2	13	SE	0.5	4	10	10	6
7	77	64	71	4	63	0	1 8	0	.77	0	30.07	10	2.0	8.9	14	SE	7.8	60	4	5	7
8	66	59	63	-4	57	2	1	0	T	0	30.19	06	6.8	9.6	12	NE	6.2	49	5	5	8
9	63	60	62	-5	58	3	1	0	T	0	30.21	05	8.6	9.1	14	E	0.4	3	10	10	9
10	70	63	67	1	62	0	1	0	0	0	30.15	10	11.7	12.4	18	E	7.6	60	10	10	10
11	74	64	69	3	64	0	1 3 8	0	.62	0	29.76	17	12.7	19.7	35	E	3.4	26	5	7	11
12	70	60	65	-1	54	0	8	0	0	0	29.68	27	13.4	15.8	23	W	6.9	54	7	4	12
13	71	58	65	-1	47	0		0	T	0	29.79	30	14.0	14.6	21	NW	11.8	94	2	3	13
14	72	57	65	-1	48	0		0	0	0	29.98	33	7.5	10.8	18	NW	12.6	100	0	1	14
15	63	54	59	-7	49	6		0	0	0	30.20	10	5.7	9.1	13	SE	12.5	100	0	0	15
16	65	55	60	-5	49	5		0	0	0	30.22	05	3.8	8.1	11	E	12.5	100	0	0	16
17	69	53	61	-4	47	4	8	0	0	0	30.21	04	6.0	8.2	14	E	12.4	100	3	4	17
18	65	58	62	-3	49	3	8	0	0	0	30.20	02	6.7	9.9	15	NE	12.4	100	8	6	18
19	74	55	65	0	52	0	1 8	0	0	0	30.22	04	1.5	7.3	16	NE	12.3	100	0	0	19
20	65	60	63	-2	58	2	2 8	0	0	0	30.28	07	4.6	7.9	11	E	12.2	99	0	3	20
21	67	56	62	-3	57	3	2 8	0	0	0	30.23	17	3.5	7.8	13	S	11.8	97	1	2	21
22	84•	62	73	9	59	0	8	0	0	0	30.09	27	10.0	11.7	17	SW	12.2	100	3	2	22
23	78	64	71	7	55	0		0	0	0	30.07	34	3.1	10.9	16	NW	12.1	100	0	0	23
24	70	60	65	1	57	0	8	0	0	0	30.08	11	2.6	10.1	14	SE	10.5	86	7	4	24
25	83	63	73	9	63	0	1 8	0	0	0	29.91	20	10.7	11.9	18	SW	10.0	83	3	4	25
26	70	64	67	4	61	0	1 8	0	.01	0	29.87	18	2.5	7.2	10	SW	6.5	54	10	8	26
27	66	60	63	0	56	2	1 8	0	T	0	29.90	02	2.5	7.5	12	SW	5.2	43	6	6	27
28	71	56	64	1	46	1	1 8	0	0	0	29.96	29	10.3	10.8	17	NW	9.4	79	2	2	28
29	67	53	60	-2	41	5		0	0	0	30.07	31	9.2	10.6	17	NW	9.3	78	4	3	29
30	69	51•	60	-2	42	5		0	0	0	29.93	26	11.7	12.4	19	W	7.4	63	8	5	30

Sum	Sum				Total	Dep.	Temperature: Number of days				
2121	1775				46	-14					
Avg.	Avg.	Avg.	Dep.	Avg.	Season to date		Max ≤ 32°	Max ≥ 90° §	Min ≤ 32°	Min ≤ 0°	
70.7	59.2	65.0	-0.5	55	Total	Dep.					
					56	-13	0	0	0	0	

Precipitation Total	Snow, sleet Total	For the month: Avg. station pressure	Resultant direction	Resultant speed	Average speed	Fastest mile Speed	Fastest mile Direction	Sunshine Total	% for month	Sky cover Sum	Sky cover Sum
1.79	0	30.06	19	.1	10.2	35	E	270.1		140	133
Dep.						Date: 11		Possible		Avg.	Avg.
-1.67								374.6	72	4.7	4.4

Greatest in 24 hours and dates: Precipitation		Snow, Sleet		Greatest depth on ground of snow, sleet or ice and date	
1.14	6- 7	0		0	

• Extreme for the month. May be the last of more than one occurrence.
- Below zero temperatures or negative departure from normal.
T In columns 9, 10, and 11 and in the Hourly Precipitation table indicates an amount too small to measure.
X Heavy fog — visibility ¼ mile or less.
§ ≥ 70° at Alaskan stations
+ Also on an earlier date, or dates

HOURLY PRECIPITATION (Liquid in Inches)

Date	A. M. Hour ending at 1	2	3	4	5	6	7	8	9	10	11	12	P. M. Hour ending at 1	2	3	4	5	6	7	8	9	10	11	12	Date
1																									
2	T	T	T	T	T	T																			1
3	.01	T																					T	.01	2
4																	T	T							3
5																									4
6										T															5
7	.08	.29	.36	.04	T	T	T	T						T	.01	.02	.02	.04	.01	.03	.01	T	.11	.12	6
8						T	T	T	T	T															7
9																									8
10																					T	T			9
11			T	T	.07	.10	.33	.10	.02	T															10
12																									11
13					T																				12
14																									13
15																									14
16																									15
17																									16
18																									17
19																									18
20																									19
21																									20
22																									21
23																									22
24																									23
25																									24
26				T		T	T	.01	T		T														25
27				T	T				T	T															26
28																									27
29																									28
30																									29
																									30

Data in columns 6, 12, 13, 14, and 15 are based on 8 observations per day at 3-hour intervals. Wind directions are those from which the wind blows. Resultant wind is the vector sum of wind directions and speeds divided by the number of observations. Figures for directions are tens of degrees from true North, i.e., 09 = East, 18 = South, 27 = West, 36 = North, and 00 = Calm. When directions are in tens of degrees in Col. 17, entries in Col. 16 are fastest observed 1-minute speeds. If the / appears in Col. 17, speeds are gusts. Any errors detected will be corrected and changes in summary data will be annotated in the annual Summary if published.

AVERAGES BY HOURS

Hour (Local time)	Sky cover (In tenths)	Station press. (In.)	Dry bulb (°F)	Wet bulb (°F)	Rel. hum. %	Dew point (°F)	Wind speed (m.p.h.)	Resultant wind Direction	Resultant wind Speed (m.p.h.)
01	5	30.07	62	58	78	55	8.1	20	2.4
04	5	30.06	60	57	80	54	8.6	30	2.5
07	5	30.08	61	57	79	54	10.0	30	3.0
10	5	30.08	65	59	71	55	11.1	05	.8
13	4	30.05	69	61	62	55	13.2	11	4.6
16	5	30.04	69	61	63	55	12.9	11	4.1
19	3	30.06	65	59	71	55	9.1	16	1.6
22	5	30.07	63	58	75	55	8.8	20	2.4

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I certify that this is an official publication of the Environmental Science Services Administration, and is compiled from records on file at the National Weather Records Center, Asheville, North Carolina 28801.

William H. Haggard
Director, National Weather Records Center

USCOMM - ESSA - ASHEVILLE 900

LOCAL CLIMATOLOGICAL DATA

U S DEPARTMENT OF COMMERCE - ALEXANDER B. TROWBRIDGE, Secretary
ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION -- ENVIRONMENTAL DATA SERVICE

BOSTON, MASSACHUSETTS
LOGAN INTERNATIONAL AIRPORT
JUNE 1967

Latitude 42° 22' N Longitude 71° 02' W Elevation (ground) 15 ft Standard time used: EASTERN

Date	Temperature (°F) Maximum	Minimum	Average	Departure from normal	Average dew point	Degree days (Base 65°)	Weather types shown by code 1-9 on dates of occurrence	Snow, Sleet, or Ice on ground at 07AM (In.)	Precipitation Total (Water equivalent) (In.)	Snow, sleet (In.)	Avg. station pressure (In.) Elev 29 feet m.s.l.	Wind Resultant direction	Resultant speed (m.p.h.)	Average speed (m.p.h.)	Fastest mile Speed (m.p.h.)	Direction	Sunshine Total (Hours and tenths)	Percent of possible	Sky cover (Tenths) Sunrise to sunset	Midnight to midnight	Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	79	47*	63	-2	39	2		0	0	0	30.11	27	9.3	13.2	17	NW	12.8	85	2	3	1
2	79	59	69	4	47	0	3	0	.06	0	30.07	17	5.5	13.7	20	NE	12.4	82	2	3	2
3	75	56	66	0	52	0		0	.01	0	30.22	11	6.0	10.8	13	E	15.1	100	0	1	3
4	76	55	66	0	50	0		0	0	0	30.29	13	10.3	12.7	16	SE	15.1	100	1	1	4
5	80	54	67	1	53	0		0	0	0	30.23	18	9.9	12.2	18	S	15.2	100	1	1	5
6	81	59	70	4	56	0	8	0	0	0	30.14	21	15.3	16.3	21	SW	14.1	93	9	7	6
7	82	60	71	4	53	0		0	0	0	30.05	22	16.8	17.7	26	SW	14.8	98	3	5	7
8	67	52	60	-7	53	5	1 8	0	.24	0	30.10	33	1.4	13.7	20	SW	0.0	0	10	10	8
9	85	52	69	2	55	0	1 8	0	T	0	30.01	20	9.4	12.9	21	SW	10.4	69	6	6	9
10	92	65	79	12	60	0		0	0	0	29.86	24	14.5	15.2	19	SW	13.1	86	4	5	10
11	77	60	69	2	59	0	8	0	0	0	29.98	09	8.4	10.2	11	E	13.5	89	2	5	11
12	83	53	68	0	56	0	1 3 8	0	.07	0	30.04	06	2.7	12.2	22	E	11.2	74	7	8	12
13	58	52	55	-13	48	10	1	0	.22	0	30.22	08	9.6	11.1	14	E	6.9	45	8	7	13
14	74	52	63	-5	47	2		0	T	0	30.24	19	11.1	12.9	22	S	5.3	34	9	9	14
15	85	57	71	3	60	0	8	0	0	0	29.94	23	16.1	16.4	19	SW	10.5	68	7	7	15
16	94*	70	82	14	65	0	8	0	0	0	29.81	26	15.4	15.7	20	SW	10.5	68	6	6	16
17	91	70	81	12	64	0	3 8	0	.01	0	29.88	21	16.5	17.4	21	SW	13.1	86	1	4	17
18	76	61	69	0	61	0	1 3 8	0	.22	0	30.06	08	1.6	11.7	13	NE	1.9	13	10	10	18
19	64	56	60	-9	54	5	1	0	.07	0	30.11	03	15.9	16.0	20	NE	0.0	0	10	10	19
20	57	50	54	-15	52	11	1	0	1.63	0	29.94	03	22.5	22.6	29	NE	0.0	0	10	10	20
21	59	50	55	-14	51	10	1	0	.02	0	29.84	01	14.5	15.5	19	NE	0.1	0	10	10	21
22	76	58	67	-2	61	0	8	0	0	0	29.88	20	14.1	14.5	20	SW	5.7	37	10	10	22
23	73	66	70	0	64	0	1 8	0	.69	0	29.88	22	13.6	14.2	20	SW	3.2	21	10	9	23
24	87	68	78	8	62	0	1 8	0	0	0	29.92	26	11.8	14.5	17	SW	14.4	94	1	2	24
25	84	65	75	5	64	0	1 3 8	0	.38	0	29.74	23	13.2	16.1	29	W	8.6	56	7	7	25
26	79	62	71	1	50	0		0	0	0	29.94	31	12.0	14.4	17	W	13.1	86	2	3	26
27	78	63	71	1	54	0		0	0	0	30.08	14	4.6	10.2	13	SE	15.2	100	1	1	27
28	74	59	67	-3	57	0	8	0	0	0	30.16	08	9.1	10.1	14	E	15.3	100	3	2	28
29	67	55	61	-9	55	4	1 8	0	T	0	30.13	09	13.3	14.1	17	E	11.1	73	7	7	29
30	57	54	56	-15	56	9	2 8	0	.06	0	29.99	07	11.1	11.7	13	E	0.0	0	10	10	30

Sum	Sum				Total	Dep.	Temperature: Number of days				
2289	1740				98	22					
Avg.	Avg.	Avg.	Dep.	Avg.	Season to date		Max ≤ 32°	Max ≥ 90°	Min ≤ 32°	Min ≤ 0°	
76.3	58.0	67.2	-0.6	55	Total	Dep.					
					5926	292	0	3	0	0	

Total	Total	For the month:						Total	%	Sum	Sum
3.48	0	30.03	20	2.9	14.0	29	W	282.6	for	169	179
Dep.						Date	25+	Possible	month	Avg.	Avg.
0.00								456.8	62	5.6	6.0

Greatest in 24 hours and dates			Greatest depth on ground of snow, sleet or ice and date
Precipitation		Snow, Sleet	
1.65	20-21	0	0

- * Extreme for the month. May be the last of more than one occurrence
- - Below zero temperatures or negative departure from normal
- T In columns 9, 10, and 11 and in the Hourly Precipitation table indicates an amount too small to measure
- X Heavy fog — visibility ¼ mile or less
- ‡ ≥ 70° at Alaskan stations
- + Also on an earlier date or dates

HOURLY PRECIPITATION (Liquid in Inches)

Date	A. M. Hour ending at 1	2	3	4	5	6	7	8	9	10	11	12	P. M. Hour ending at 1	2	3	4	5	6	7	8	9	10	11	12	Date
1																									
2				T	T																				1
3	.01																.03	T						.03	2
4																									3
5																									4
6																									5
7																									6
8							T	.03	.16	.03	.01	.01	T	T											7
9		T																							8
10																									9
11																									10
12																									11
13			T	T	.10	.09	.03	T									T	.05	.02	T					12
14																									13
15																T	T	T	T	T	T				14
16																									15
17																									16
18	.01																					T		.01	17
19	.01	.01	.05	T	T	T				T	T		T		.01 T	.05 T	.03	.07	.03	.02	T	T	T	T	18
20					T	T	T	.20	.29	.22	.05	.16	.04	.02	.11	.05	.02	T	.01	.04	.07	.05	.09	.01	19
21	T	T	.01	T	.01	T	T	T	T	T	T	T	T	T											20
22																									21
23	.01	.01		T				.01	T	T	.06	.01		.35	.24	T									22
24																									23
25																									24
26																	.08	.30	T						25
27																									26
28																									27
29																									28
30	T	T	T	T	T	T	T	T	T	T	T		.01	.02	T	.02	.01					T	T	T	29
																									30

Data in columns 6, 12, 13, 14, and 15 are based on 8 observations per day at 3-hour intervals. Wind directions are those from which the wind blows. Resultant wind is the vector sum of wind directions and speeds divided by the number of observations. Figures for directions are tens of degrees from true North, i.e., 09 = East, 18 = South, 27 = West, 36 = North, and 00 = Calm. When directions are in tens of degrees in Col. 17, entries in Col. 16 are fastest observed 1-minute speeds. If the * appears in Col. 17, speeds are gusts. Any errors detected will be corrected and changes in summary data will be annotated in the annual Summary if published.

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I certify that this is an official publication of the Environmental Science Services Administration, and is compiled from records on file at the National Weather Records Center, Asheville, North Carolina 28801.

William H. Haggard
Director, National Weather Records Center

AVERAGES BY HOURS

Hour (Local time)	Sky cover (In tenths)	Station pres. (In.)	Dry bulb	Wet bulb	Rel. hum. %	Dew point	Wind speed (m.p.h.)	Resultant wind Direction	Speed (m.p.h.)
01	6	30.03	62	58	77	55	12.3	24	4.9
04	6	30.03	61	57	80	54	11.3	25	3.4
07	5	30.05	63	58	75	55	12.0	23	2.7
10	4	30.04	70	62	63	56	14.7	12	1.8
13	6	30.02	72	62	59	55	17.0	14	2.9
16	6	30.00	72	62	60	55	16.9	15	3.9
19	7	30.01	67	60	69	56	14.8	18	5.0
22	7	30.03	64	59	73	55	13.0	22	5.4

USCOMM ESSA ASHEVILLE 900

LOCAL CLIMATOLOGICAL DATA

U. S. DEPARTMENT OF COMMERCE - ALEXANDER B. TROWBRIDGE, Acting Secretary
ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION -- ENVIRONMENTAL DATA SERVICE

BOSTON, MASSACHUSETTS
LOGAN INTERNATIONAL AIRPORT
MAY 1967

Latitude 42° 22′ N Longitude 71° 02′ W Elevation (ground) 15 ft. Standard time used: EASTERN

Date	Temperature (°F) Maximum	Minimum	Average	Departure from normal	Average dew point	Degree days (Base 65°)	Weather types shown by code 1-9 on dates of occurrence	Snow, Sleet, or Ice on ground at 07AM (In.)	Precipitation Total (Water equivalent) (In.)	Snow, sleet (In.)	Avg. station pressure (In.) Elev. 29 feet m.s.l.	Wind Resultant direction	Resultant speed (m.p.h.)	Average speed (m.p.h.)	Fastest mile Speed (m.p.h.)	Direction	Sunshine Total (Hours and tenths)	Percent of possible	Sky cover (Tenths) Sunrise to sunset	Midnight to midnight	Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	56	41	49	-5	36	16	8	0	0	0	30.13	11	8.9	13.4	17	E	14.1	100	2	1	1
2	52	41	47	-7	39	18	1 8	0	.20	0	30.10	11	9.5	11.1	18	E	6.0	43	8	8	2
3	60	42	51	-3	40	14	2	0	.15	0	29.92	31	10.7	17.4	24	NW	5.7	40	8	7	3
4	65	42	54	-1	28	11		0	0	0	30.27	24	9.1	15.4	21	SW	11.2	79	8	6	4
5	61	45	53	-2	38	12	3 8	0	.14	0	30.20	18	5.7	12.1	18	N	10.6	75	6	7	5
6	49	42	46	-10	37	19	8	0	.12	0	30.11	33	3.0	10.4	16	NW	1.9	13	9	9	6
7	46	37*	42	-14	37	23	1 4 8	0	1.13	T	29.75	08	18.0	21.0	43	NE	5.1	36	9	9	7
8	55	39	47	-9	37	18	1	0	.07	0	29.24	28	11.7	17.8	23	W	5.1	36	9	10	8
9	52	44	48	-8	43	17	1 8	0	.47	0	29.35	06	8.4	11.7	17	NE	2.6	16	10	10	9
10	53	44	49	-8	37	16		0	.30	0	29.57	30	18.2	18.3	24	NW	2.9	20	10	9	10
11	54	42	48	-9	37	17	1	0	.41	0	29.76	19	5.0	16.3	26	SE	7.3	50	10	8	11
12	60	43	52	-5	34	13	1	0	.02	0	29.69	32	21.4	21.6	27	NW	10.3	71	6	5	12
13	66	45	56	-2	26	9		0	0	0	29.96	30	16.9	17.4	26	NW	14.3	100	3	2	13
14	66	47	56	-2	31	9		0	T	0	29.98	15	4.5	13.7	23	S	13.6	93	5	5	14
15	51	44	48	-11	43	17	1 8	0	.32	0	29.70	09	5.8	12.4	18	E	0.0	0	10	10	15
16	56	45	52	-7	34	13		0	T	0	29.80	29	21.6	22.0	30	NW	12.3	84	4	3	16
17	69	45	57	-2	32	8		0	0	0	30.00	25	19.6	20.4	30	SW	13.3	91	2	2	17
18	74	48	61	1	38	4		0	0	0	29.93	27	10.5	15.7	26	NW	10.2	70	6	7	18
19	77*	48	63	3	47	2	8	0	T	0	29.84	20	14.8	16.7	30	S	9.1	62	10	10	19
20	76	51	64	4	42	1	8	0	0	0	29.62	26	14.1	17.8	30	W	9.4	64	8	8	20
21	66	47	56	-5	27	9		0	0	0	30.14	28	15.6	16.0	21	W	12.6	85	9	8	21
22	54	47	51	-10	37	14		0	0	0	30.15	07	6.3	12.7	17	E	10.6	72	7	7	22
23	52	40	46	-16	41	19	1	0	0	0	30.21	09	7.0	10.4	13	E	14.2	96	7	7	23
24	53	40	47	-15	38	18	1 8	0	0	0	30.29	07	13.9	14.2	21	NE	10.9	73	10	10	24
25	49	40	45	-17	38	20	1 3	0	2.63	0	29.98	04	34.3	34.7	50	NE	0.0	0	10	10	25
26	44	41	43	-20	39	22	1 8	0	1.36	0	29.80	01	22.8	23.2	37	NE	0.0	0	10	10	26
27	52	43	48	-15	38	17	1	0	T	0	29.87	03	7.8	15.2	23	N	7.0	47	8	8	27
28	73	48	61	-3	43	4		0	0	0	29.90	35	3.3	10.6	17	N	14.7	98	1	1	28
29	67	50	59	-3	39	6	8	0	0	0	29.89	26	3.4	9.4	14	E	6.5	43	10	8	29
30	71	49	60	-4	28	5		0	T	0	29.80	31	13.0	15.7	23	NW	9.2	61	3	4	30
31	58	47	53	-12	35	12		0	0	0	30.03	13	1.2	15.8	18	NW	11.7	78	4	4	31

Sum	Sum				Total	Dep.
1839	1367				403	193
Avg.	Avg.	Avg.	Dep.	Avg.	Season to date Total	Dep.
59.3	44.1	51.7	-7.1	37	5868	270

Temperature: Number of days Max ≥ 90°‡	Max ≤ 32°	Min ≤ 32°	Min ≤ 0°
0	0	0	0

Precipitation Total	Snow, sleet Total	For the month: Avg. station pressure	Resultant direction	Resultant speed	Average speed	Fastest mile Speed	Direction	Sunshine Total	% for month	Sky cover Sum	Sum
7.32	T	29.91	32	3.6	16.1	50	NE	282.6	65	222	214
Dep.						Date: 25		Possible		Avg.	Avg.
3.98								432.7		7.2	6.9

Greatest in 24 hours and dates: Precipitation		Snow, Sleet		Greatest depth on ground of snow, sleet or ice and date	
3.64	25-26	T	7	T	7

* Extreme for the month. May be the last of more than one occurrence.
- Below zero temperatures or negative departure from normal.
T In columns 9, 10, and 11 and in the Hourly Precipitation table indicates an amount too small to measure.
X Heavy fog — visibility ¼ mile or less.
‡ ≥ 70° at Alaskan stations.
+ Also on an earlier date, or dates.

HOURLY PRECIPITATION (Liquid in Inches)

Date	A. M. Hour ending at 1	2	3	4	5	6	7	8	9	10	11	12	P. M. Hour ending at 1	2	3	4	5	6	7	8	9	10	11	12	Date
1																									1
2																T	T	T	.04	.04	.04	.02	.05	.01	2
3	.01	.01	T	T	T	.08	.03	.02	T																3
4																									4
5														T	.02	.04		T	T	T	.02	T	.06	T	5
6	T	T	.01	T						T	.01	.04	.05	T	.01	T									6
7																.05	.08	.08	.27	.41	.09	.10	.03	.02	7
8	.01	.01	.04	T				T	T												T	.01	T	T	8
9																	.03	.03	.17	.07	T	T	.05	.12	9
10	.10	.04	.02	.09	.01	.01	.01	.01	.01	T	T	T	T	T	T			T	T	T	T				10
11															T	.01	.05	.04	T	.05	.06	.17	.02	.01	11
12	T	.02	T	T																					12
13																									13
14																							T	T	14
15	T	T	T	T				T	T	.01	T	.01	.04	.08	.01	T	T	.02	.02	.10	.01	.01	T	.01	15
16	T																								16
17																									17
18																									18
19			T	T	T	T	T	T														T			19
20																									20
21																									21
22																									22
23																									23
24																									24
25	T	T	T	T	.06	.09	.01	.04	.05	.23	.19	.20	.14	.15	.05	.05	.05	.22	.26	.35	.08	.07	.13	.23	25
26	.29	.25	.14	.13	.09	.13	.09	.06	.06	.04	.01	T	T	T	T	T	T	.01	.02	.01	.01	T	T	T	26
27	T																								27
28																									28
29																									29
30																		T	T	T					30
31																									31

Data in columns 6, 12, 13, 14, and 15 are based on 8 observations per day at 3-hour intervals. Wind directions are those from which the wind blows. Resultant wind is the vector sum of wind directions and speeds divided by the number of observations. Figures for directions are tens of degrees from true North, i.e., 09 = East, 18 = South, 27 = West, 36 = North, and 00 = Calm. When directions are in tens of degrees in Col. 17, entries in Col. 16 are fastest observed 1-minute speeds. If the / appears in Col. 17, speeds are gusts. Any errors detected will be corrected and changes in summary data will be annotated in the annual Summary if published.

AVERAGES BY HOURS

Hour (Local time)	Sky cover (tenths)	Station pressure (In.)	Dry bulb (°F)	Wet bulb (°F)	Relative humidity (%)	Dew pt. (°F)	Wind speed (m.p.h.)	Resultant wind Direction	Speed (m.p.h.)
01	7	29.90	48	42	66	36	13.8	30	7.1
04	6	29.90	46	42	71	36	13.5	31	5.9
07	7	29.94	49	43	67	37	14.6	32	7.0
10	7	29.93	54	46	57	37	17.0	34	2.7
13	8	29.90	56	47	54	37	18.9	16	.4
16	7	29.89	56	47	55	37	19.5	02	2.6
19	7	29.90	52	45	61	37	17.0	02	3.3
22	7	29.91	50	44	64	36	14.7	30	4.1

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I certify that this is an official publication of the Environmental Science Services Administration, and is compiled from records on file at the National Weather Records Center, Asheville, North Carolina 28801

William H. Haggard
Director, National Weather Records Center

F-7

LOCAL CLIMATOLOGICAL DATA

U. S. DEPARTMENT OF COMMERCE - ALEXANDER B. TROWBRIDGE, Secretary
ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION — ENVIRONMENTAL DATA SERVICE

BOSTON, MASSACHUSETTS
LOGAN INTERNATIONAL AIRPORT
JULY 1967

Latitude 42° 22′ N Longitude 71° 02′ W Elevation (ground) 15 ft. Standard time used: EASTERN

Date	Temperature (°F) Maximum	Temperature (°F) Minimum	Temperature (°F) Average	Temperature (°F) Departure from normal	Temperature (°F) Average dew point	Temperature (°F) Degree days (Base 65°)	Weather types shown by code 1-9 on dates of occurrence 1 2 3 4 5 6 7 8 9	Snow, Sleet, or Ice on ground at 07AM (In.)	Precipitation Total (Water equivalent) (In.)	Precipitation Snow, sleet (In.)	Avg. station pressure (In.) Elev. 29 feet m.s.l.	Wind Resultant direction	Wind Resultant speed (m.p.h.)	Wind Average speed (m.p.h.)	Wind Fastest mile Speed (m.p.h.)	Wind Fastest mile Direction	Sunshine Total (Hours and tenths)	Sunshine Percent of possible	Sky cover (Tenths) Sunrise to sunset	Sky cover (Tenths) Midnight to midnight	Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	78	56*	67	-4	61	0	1 8	0	T	0	29.94	23	15.0	15.5	17	SW	8.4	55	7	7	1
2	82	66	74	3	65	0	1 8	0	.05	0	29.90	21	16.6	17.8	22	SW	8.8	57	7	7	2
3	80	65	73	1	65	0	1	0	1.03	0	29.72	22	6.1	11.7	12	S	5.6	37	8	8	3
4	77	67	72	0	56	0		0	.03	0	29.87	25	3.3	13.7	16	SW	10.5	69	7	8	4
5	75	63	69	-3	59	0	1 3 8	0	.35	0	29.97	32	8.6	11.2	15	SW	4.7	31	9	8	5
6	76	62	69	-3	53	0		0	0	0	30.22	29	9.8	12.8	15	NW	7.6	50	6	9	6
7	80	61	71	-1	53	0		0	0	0	30.28	26	12.7	14.1	20	SW	15.1	99	3	2	7
8	84	65	75	2	58	0	8	0	0	0	30.17	24	15.3	15.5	18	W	14.0	93	6	6	8
9	81	70	76	3	66	0	8	0	T	0	29.99	24	9.8	11.7	17	SW	4.2	28	10	10	9
10	89*	73	81	8	66	0	8	0	0	0	29.87	25	5.4	11.1	12	SE	9.5	63	6	8	10
11	77	64	71	-2	64	0	2 8	0	T	0	29.85	06	10.6	12.2	13	E	4.9	30	10	10	11
12	71	62	67	-7	63	0	2 8	0	.15	0	29.69	07	6.8	9.6	14	NE	7.1	47	6	6	12
13	78	64	71	-3	65	0	1 8	0	0	0	29.70	19	9.1	11.8	18	SW	1.2	8	10	9	13
14	80	68	74	0	65	0	1 8	0	T	0	29.81	19	5.8	12.1	15	E	4.5	30	9	10	14
15	76	67	72	-2	66	0	1 8	0	.30	0	30.01	16	8.3	11.9	13	SW	2.9	19	9	9	15
16	80	70	75	1	66	0		0	.02	0	30.12	20	12.3	13.7	24	SW	1.8	12	10	10	16
17	77	64	71	-4	64	0	2 8	0	T	0	30.16	11	6.5	10.4	12	E	10.2	68	5	6	17
18	70	64	67	-8	63	0	2 8	0	T	0	30.19	08	9.8	11.2	12	E	0.2	1	10	10	18
19	75	65	70	-5	64	0	2 8	0	T	0	30.22	13	6.4	9.5	12	SW	4.4	30	9	10	19
20	74	66	70	-5	62	0	1 8	0	.09	0	30.22	13	5.1	8.1	10	SE	0.8	5	10	10	20
21	75	65	70	-5	64	0	1 8	0	T	0	30.13	13	8.8	9.8	12	SE	8.9	60	9	9	21
22	77	70	74	-1	65	0	1 8	0	0	0	30.03	17	9.2	12.9	16	SE	9.3	63	5	6	22
23	81	67	74	-1	66	0	3 8	0	.23	0	29.94	20	11.6	15.2	26	SW	4.0	27	9	8	23
24	88	72	80	5	67	0	8	0	T	0	29.83	22	16.2	16.7	23	SW	8.9	60	7	8	24
25	88	72	80	5	66	0	3 8	0	.14	0	29.73	22	12.8	14.5	22	W	8.5	58	8	8	25
26	84	70	77	2	60	0		0	0	0	29.79	27	12.8	13.4	17	W	13.7	94	6	4	26
27	86	67	77	1	60	0	8	0	0	0	29.91	20	8.2	10.9	17	SW	11.4	78	5	6	27
28	80	68	74	-2	65	0	8	0	.08	0	29.87	20	7.1	10.6	14	SW	3.6	25	9	9	28
29	81	65	73	-3	63	0	1 8	0	0	0	29.82	10	2.3	9.4	14	SE	12.5	85	6	7	29
30	80	70	75	0	65	0	8	0	T	0	29.83	18	8.1	11.5	14	SE	5.4	37	10	10	30
31	83	69	76	1	65	0	1 8	0	0	0	29.85	19	7.3	11.4	16	SW	10.5	73	5	7	31

Sum	Sum	——	——	——	Total	Dep.	Temperature:	Total	Total	For the month:					Total	% for month	Sum	Sum
2463	2057	——	——	——	0	0	Number of days	2.67	0	29.96	21	5.4	12.3	26 SW	222.7		236	239
Avg.	Avg.	Avg.	Dep.	Avg.	Season to date		Max. ≤ 32° / Max. ≥ 90°‡ / Min. ≤ 32° / Min. ≤ 0°	Dep.	——	——	——	——	——	Date: 23	Possible		Avg.	Avg.
79.5	66.4	73.0	-0.7	63	Total	Dep.		-0.41	——	——	——	——	——	——	462.7	48	7.6	7.7
					0	0	0 0 0 0											

Greatest in 24 hours and dates: Precipitation		Snow, Sleet		Greatest depth on ground of snow, sleet or ice and date	
1.08	2- 3	0		0	

* Extreme for the month. May be the last of more than one occurrence.
‡ ≥ 70° at Alaskan stations.
+ Also on an earlier date, or dates.
- Below zero temperatures or negative departure from normal.
T In columns 9, 10, and 11 and in the Hourly Precipitation table indicates an amount too small to measure.
※ Heavy fog — visibility ¼ mile or less.

HOURLY PRECIPITATION (Liquid in Inches)

Date	A.M. 1	2	3	4	5	6	7	8	9	10	11	12	P.M. 1	2	3	4	5	6	7	8	9	10	11	12	Date
1				T	T																				1
2																		T	.05	T			T	T	2
3	.01		T	T	T	T	.06	.32	.45	.07	.12	T	T												3
4																						T	.01	.02	4
5	.13	.08	T	.02	T	T	T		T	.01						T	.11	T							5
6																									6
7																									7
8																									8
9												T	T												9
10																									10
11																T					T	T	T	T	11
12	T	T	T	T	T	.06	.07	.02	T																12
13																									13
14																					T				14
15										.01	.19	.10	T			T	T								15
16						T						.02	T	T		T	T	T						T	16
17	T	T	T																						17
18			T	T	T		T	T					T	T	T									T	18
19	T	T	T	T	T	T	T	T				T													19
20	T										T	T	.05	.02	.01	.01	T	T	T				T	T	20
21		T	T																						21
22																									22
23													.01	T	.21	.01									23
24																				T	T				24
25						.05	.04	T												T	.05				25
26																									26
27																									27
28																	T	.01	.03	.02	.01	.01	T		28
29																									29
30			T	T	T	T	T	T																	30
31																									31

Data in columns 6, 12, 13, 14, and 15 are based on 8 observations per day at 3-hour intervals. Wind directions are those from which the wind blows. Resultant wind is the vector sum of wind directions and speeds divided by the number of observations. Figures for directions are tens of degrees from true North; i.e., 09 = East, 18 = South, 27 = West, 36 = North, and 00 = Calm. When directions are in tens of degrees in Col. 17, entries in Col. 16 are fastest observed 1-minute speeds. If the / appears in Col. 17, speeds are gusts. Any errors detected will be corrected and changes in summary data will be annotated in the annual Summary if published.

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I certify that this is an official publication of the Environmental Science Services Administration, and is compiled from records on file at the National Weather Records Center, Asheville, North Carolina 28801.

William H. Haggard
Director, National Weather Records Center

AVERAGES BY HOURS

Hour (Local time)	Sky cover (in tenths)	Station press. (In.)	Dry bulb (°F)	Wet bulb (°F)	Rel. hum. %	Dew pt. (°F)	Wind speed (m.p.h.)	Resultant wind Direction	Resultant wind Speed (m.p.h.)
01	8	29.96	69	65	80	62	11.4	24	6.6
04	9	29.95	67	64	82	62	9.5	22	5.2
07	9	29.98	69	65	79	62	10.3	24	4.4
10	7	29.97	74	67	69	63	12.3	19	4.3
13	8	29.95	77	68	66	64	15.0	16	6.0
16	8	29.93	76	68	66	64	14.5	17	6.2
19	7	29.94	74	67	71	64	13.2	21	7.8
22	7	29.96	71	66	76	63	12.3	23	8.8

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LOCAL CLIMATOLOGICAL DATA

U S DEPARTMENT OF COMMERCE - ALEXANDER B. TROWBRIDGE, Secretary
ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION -- ENVIRONMENTAL DATA SERVICE

BOSTON, MASSACHUSETTS
LOGAN INTERNATIONAL AIRPORT
AUGUST 1967

Latitude 42° 22' N Longitude 71° 01' W Elevation (ground) 15 ft. Standard time used: EASTERN

Date	Temperature (°F) Maximum	Minimum	Average	Departure from normal	Average dew point	Degree days (Base 65°)	Weather types shown by code 1-9 on dates of occurrence (1 Fog, 2 Heavy fog, 3 Thunderstorm, 4 Ice pellets, 5 Hail, 6 Glaze, 7 Duststorm, 8 Smoke, Haze, 9 Blowing snow)	Snow, Sleet, or Ice on ground at 07AM (In.)	Precipitation Total (Water equivalent) (In.)	Snow, sleet (In.)	Avg. station pressure (In.) Elev. 29 feet m.s.l.	Wind Resultant direction	Resultant speed (m.p.h.)	Average speed (m.p.h.)	Fastest mile Speed (m.p.h.)	Direction	Sunshine Total (Hours and tenths)	Percent of possible	Sky cover (Tenths) Sunrise to sunset	Midnight to midnight	Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	77	66	72	-3	63	0	1 3 8	0	.56	0	29.87	11	6.6	10.1	14	E	7.6	53	5	6	1
2	74	64	69	-6	60	0		0	0	0	30.08	08	8.1	12.5	13	SE	14.1	98	2	2	2
3	77	64	71	-4	63	0	1 8	0	T	0	30.08	18	12.5	12.8	19	SW	0.9	6	10	9	3
4	84	72	78	3	67	0	3 8	0	.08	0	29.93	21	15.1	16.1	29	SW	2.1	15	10	10	4
5	79	70	75	0	66	0	3 8	0	.09	0	29.94	18	8.9	10.5	11	SE	5.8	41	9	7	5
6	71	63	67	-8	61	0	1 3 8	0	2.60	0	29.98	06	5.0	9.4	15	N	0.1	1	10	10	6
7	75	62	69	-6	59	0	8	0	0	0	30.04	16	3.7	10.9	12	SE	9.6	68	3	4	7
8	73	63	68	-6	61	0	1 8	0	0	0	30.09	17	6.9	10.5	13	E	4.2	30	9	9	8
9	79	60	70	-4	60	0	1 8	0	.08	0	29.91	17	11.1	12.8	17	SW	10.7	73	2	5	9
10	80	70	75	1	66	0	8	0	.09	0	29.73	22	12.6	14.2	16	SW	3.7	26	9	9	10
11	70	62	66	-7	52	0		0	0	0	30.01	36	1.8	10.4	14	NW	6.2	44	9	9	11
12	70	61	66	-7	55	0		0	T	0	30.14	03	8.1	9.6	13	E	2.6	19	10	10	12
13	69	61	65	-8	56	0	1	0	.31	0	30.08	02	10.7	12.8	17	NE	0.4	3	10	10	13
14	76	61	69	-4	59	0	1	0	.05	0	29.98	30	3.7	12.2	19	N	8.3	60	9	7	14
15	81	61	71	-2	58	0	8	0	0	0	30.12	23	5.3	9.8	11	SE	13.1	94	3	2	15
16	83	67	75	3	57	0	8	0	0	0	30.20	25	7.0	11.4	12	W	13.9	100	1	2	16
17	84	68	76	4	58	0	8	0	0	0	30.16	22	11.5	12.7	15	SW	10.3	74	9	9	17
18	86*	68	77	6	57	0	8	0	0	0	29.97	24	13.9	14.1	18	SW	12.8	93	2	3	18
19	85	71	78	7	62	0	8	0	T	0	29.88	21	12.0	13.1	20	SW	9.8	71	7	7	19
20	85	68	77	6	61	0	8	0	T	0	29.84	21	12.3	13.8	28	SW	5.9	43	9	8	20
21	80	66	73	2	62	0	8	0	0	0	29.95	20	8.5	12.8	16	S	7.8	57	7	7	21
22	80	70	75	5	63	0	8	0	T	0	29.97	25	10.5	12.8	16	SW	11.1	81	8	8	22
23	70	60	65	-5	50	0		0	0	0	30.26	35	3.6	11.4	17	NW	12.3	91	9	8	23
24	70	56*	63	-7	56	2	8	0	0	0	30.43	08	7.1	8.8	11	E	12.3	91	8	7	24
25	66	61	64	-6	58	1	1	0	.17	0	30.30	08	8.2	8.6	10	NE	4.4	32	10	10	25
26	67	61	64	-5	62	1	1	0	.43	0	30.07	07	4.6	6.9	7	E	0.0	0	10	10	26
27	83	68	76	5	68	0	1 8	0	.09	0	29.89	21	11.8	12.9	17	S	5.8	44	9	10	27
28	83	66	75	6	66	0	3	0	.47	0	29.82	21	14.5	16.0	20	SW	8.6	66	7	6	28
29	79	62	71	3	58	0	8	0	0	0	29.92	27	12.5	12.9	15	SW	10.2	77	3	2	29
30	84	64	74	6	61	0	8	0	0	0	29.94	23	11.0	12.5	17	SW	12.0	90	2	2	30
31	81	57	69	1	60	0	1 3 8	0	.68	0	30.01	28	11.5	15.2	27	NW	7.3	56	6	6	31

Sum 2401	Sum 1990	Degree days Total 6	Dep. -5	Temperature: Number of days			
Avg. 77.5	Avg. 64.2	Avg. 70.9	Dep. -0.8	Avg. 60			
Season to date Total 6	Dep. -5	Max ≥ 90°‡ 0	Max ≤ 32° 0	Min ≤ 32° 0	Min ≤ 0° 0		
Precipitation Total 5.76	Dep. 2.08	Snow, sleet Total 0					
For the month: Pressure 30.02	Resultant direction 21	Resultant speed 4.6	Average speed 11.9	Fastest mile 29	SW	Date: 04	
Sunshine Total 253.9	Possible 429.6	% for month 59	Sky cover Sum 217	Sum 216	Avg. 7.0	Avg. 6.9	
Greatest in 24 hours and dates: Precipitation 2.60	6	Snow, Sleet 0		Greatest depth on ground of snow, sleet or ice and date 0			

- * Extreme for the month. May be the last of more than one occurrence
- - Below zero temperatures or negative departure from normal
- T In columns 9, 10 and 11 and in the Hourly Precipitation table indicates an amount too small to measure
- X Heavy fog — visibility ¼ mile or less
- ‡ ≥ 70° at Alaskan stations
- + Also on an earlier date, or dates

HOURLY PRECIPITATION (Liquid in Inches)

Date	A.M. Hour ending at 1	2	3	4	5	6	7	8	9	10	11	12	P.M. Hour ending at 1	2	3	4	5	6	7	8	9	10	11	12	Date
1				T	.01	.01	.01													.51	.04				1
2																									2
3													T	T	T	T									3
4					T	T	T	.04	T					.03	.01	T									4
5	.05	.03	.01	T	T	T	T	T	T																5
6					T	.05	.69	1.56	.25	.05	T	T								T					6
7																									7
8																									8
9																						T	.02	.06	9
10	.06	.01													.02										10
11																									11
12																	T	T							12
13												T				T	.02	.04	.01	T	.02	.09	.07	.06	13
14	.03	.01	T	T	T	.01																			14
15																									15
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Data in columns 6, 12, 13, 14, and 15 are based on 8 observations per day at 3-hour intervals. Wind directions are those from which the wind blows. Resultant wind is the vector sum of wind directions and speeds divided by the number of observations. Figures for directions are tens of degrees from true North; i.e., 09 = East, 18 = South, 27 = West, 36 = North, and 00 = Calm. When directions are in tens of degrees in Col. 17, entries in Col. 16 are fastest observed 1-minute speeds. If the / appears in Col. 17 speeds are gusts. Any errors detected will be corrected and changes in summary data will be annotated in the annual Summary if published.

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I certify that this is an official publication of the Environmental Science Services Administration, and is compiled from records on file at the National Weather Records Center, Asheville, North Carolina 28801.

William H. Haggard
Director, National Weather Records Center

AVERAGES BY HOURS

Hour (Local time)	Sky cover (In tenths)	Station press. (In.)	Dry bulb (°F)	Wet bulb (°F)	Rel. hum. (%)	Dew point (°F)	Wind speed (m.p.h.)	Resultant wind Direction	Speed (m.p.h.)
01	7	30.01	67	62	76	59	11.6	25	5.8
04	7	30.01	66	62	78	59	10.2	25	4.3
07	7	30.03	67	62	77	59	10.5	26	3.4
10	6	30.04	73	65	68	61	11.6	20	2.8
13	8	30.02	75	66	63	61	13.7	18	5.4
16	7	29.99	75	66	64	61	13.8	17	6.8
19	6	30.00	71	65	71	61	12.3	19	6.8
22	7	30.03	69	63	73	59	11.7	23	6.0

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APPENDIX G

APPENDIX G

UNITED STATES ARMY CORPS OF ENGINEER DEBRIS STUDY

1. Study Authorization and Purpose. Study being made under authority of Resolution by the Committee on Public Works of the United States Senate, adopted March 18, 1966. The study will determine the cause, extent and seriousness of the existing debris problem in Boston Harbor resulting from drift from dilapidated waterfront structures, derelicts and other injurious obstructions to navigation. The study will also determine the cost, feasibility and economic justification of a program to solve or significantly correct the problem.

2. Location and General Description.

a. The port of Boston, Massachusetts, is the largest seaport in New England, considered both from the standpoint of its waterfront facilities and the extent of its waterborne commerce. Boston is the principal distribution point for the commerce of Massachusetts, New Hampshire, and Vermont, and it affords a short route between Europe and the interior of the United States and Canada. In this section of the country, the port serves as a gateway for the foreign and coastwide receipts of raw materials for a large industrial area producing machinery, textiles, rubber and leather goods, and wood and petroleum products.

b. Boston Harbor is located on the westerly side of Massachusetts Bay about 51 nautical miles northwest of the tip of Cape Code. It includes all the tidewater lying landward of a line from Point Allerton to the end of Deer Island, a water of about 47 square miles.

Reproduced from best available copy.

3. Improvement Desired by Local Interests.

At the pre-hearing meeting held on May 15, 1967 at the John F. Kennedy Federal Building, Boston, and attended by about 20 representatives of private, industrial and governmental interests concerned with debris control in the harbor, it appeared that local interests desire an effective waterfront cleanup program aimed at the elimination of all derelicts and dilapidated shorefront structures and debris in Boston Harbor.

4. Corps of Engineers Responsibilities and Functions in Boston Harbor.

a. Development and maintenance of major navigation channels and anchorages, as authorized by Congress.

b. Issuance of permits for structures in tidewater beyond the Federal Harbor Line.

c. Establishment of regulations for dumping grounds and inspection of disposal operations.

d. Removal and disposal (to a limited degree only) of floating hazards to navigation. Hazardous drift and debris in Boston Harbor is presently being removed by the Corps of Engineers (Corps) to a limited degree by a commercial vessel under contract. Limited funds (in recent years averaging $15,000) to perform this work are allocated from maintenance funds. Harbor patrols of 4 hours duration are made regularly three times each week to pick up floating debris which could be harmful to navigation. Frequent additional patrols are made to pick up specific items of hazardous debris as directed on a 24-hour basis. Further extra patrols are ordered during periods of extremely high tides to remove flotsam which has floated off the shores. The U. S. Coast Guard and Boston Harbor Police cooperate in retrieving hazardous drift. The program is not a satisfactory solution to the debris problem, but it does serve to reduce the hazard to small boats.

e. Removal and disposal of sunken vessels which constitute a menance to general navigation. The Corps is authorized to remove sunken or derelict vessels which are considered to be a menace to general navigation. The New England Division recently removed three derelict vessels in Boston Harbor. Another was removed by a joint effort of the Corps and the U. S. Coast Guard. The Massachusetts Department of Public Works has recently removed 3 sunken barges in the harbor.

f. Enforcement of the Refuse Act (U.S. Code Title 33, Chapter 407, Rivers and Harbors Act of March 3, 1899) prohibiting discharge of solid wastes (including oil and/or petroleum products) into tidewater. Enforcement is done on an intermittent basis by the Corps of Engineers personnel and regularly by the U. S. Coast Guard. The Coast Guard investigates cases of refuse dumping and reports them to the Corps of Engineers for prosecution through the U. S. Department of Justice.

The Port of Boston, unlike New York Harbor, Hampton Roads or Baltimore Harbor, has never been the subject of an authorizing statute to collect and/or remove debris in the harbor.

g. Collection and publication of port's commercial statistics and publication of port information concerning terminal facilities in conjunction with Maritime Administration.

5. Scope of Study.

a. Area covered by study: Boston Harbor and its tributary waters.

b. Ten communities about Boston Harbor. Proceeding clockwise from the south, they are: towns of Hull, Hingham, Weymouth and Braintree; cities of Quincy, Boston, Cambridge, Everett, and Chelsea: and the town of Winthrop and Deer Island (Boston).

6. Tentative Study Outline.

a. General information - definition of words and terms and geographical limitations of study.

b. Survey of derelict vessels and dilapidated shorefront structures within study area.

(1) Derelict Vessels

(a) Type, size, condition and owner

(b) Method and estimated cost of removal and disposal. Disposal site.

(c) Volume of floatable debris which would result from vessel break-up.

(2) Dilapidated Shorefront Structures

(a) Type, size, condition, present use and owner of structure.

(b) Status of Federal and/or State permit or license authorizing structure.

(c) Method and estimated cost of removal and disposal.

(d) Volume of floatable debris which would result from structure break-up.

c. **Floating Debris**

(1) Sources, types and quantities.

(2) Estimated cost of collection and disposal. Disposal site.

d. Boat Damage Estimate. Estimated annual damages to vessels from collision with floating debris or derelict vessels.

e. Legal work involved in these studies includes, but is not restricted to, the following items:

(1) Review of existing Federal, State and municipal statutes to determine their adequacy to provide for the removal and/or repair of dilapidated shorefront structures and derelicts in tidewaters which are or may become obstructions or nuisances to navigation. No recommendations for corrective legislation to accomplish the above are contemplated in this study as it is understood that appropriate revisions to the provisions of the Rivers and Harbors Act of 1899 and other existing legislation relating to the protection of the Nation's waterways will be recommended in the study called for by Section 313 of the Rivers and Harbor Act of 1965 for revising and codifying the general and permanent laws relating to water resources development projects by the Corps.

(2) Review and determination of the rights of the owners of such structures and derelicts.

(3) Determination as to the rights of the Federal, State or municipal governments to enter; alter, repair or remove materials from such structures and derelicts.

(4) Rights of the Federal, State or municipal governments to any funds from the sale of materials or products by said removal.

(5) Review of government or local statutes or ordinances concerning disposal of such materials by burning or other means.

(6) Legal aspects of requirements of local cooperation that may be involved in the initial cleanup and subsequent maintenance of properties to minimize future drift.

f. Evaluation of land enhancement that could be expected to result from removal of derelicts and shorefront dilapidated structures.

7. Program to Solve or Significantly Correct the Problem

a. Method or plan - total first cost

b. Est. of annual cost

c. Est. of annual benefits

(1) reduction in boat damages

(2) reduction in cost of present debris collection program

(3) reduction in cost for cleanup of shores of public beaches in area

(4) land enhancement, certain shore properties

(5) reduction of fire hazards

(6) reduction of water pollution (from debris only)

(7) reduction of infestation of marine borers

(8) reduction in hazards to life from drift, derelict vessels and dilapidated shore structures

(9) esthetic improvement of harbor.

8. Conclusions

9. Recommendations

10. Study Funding and Scheduling

The estimated total cost of the debris study is $100,000. The study is scheduled to be completed in the summer of 1971.

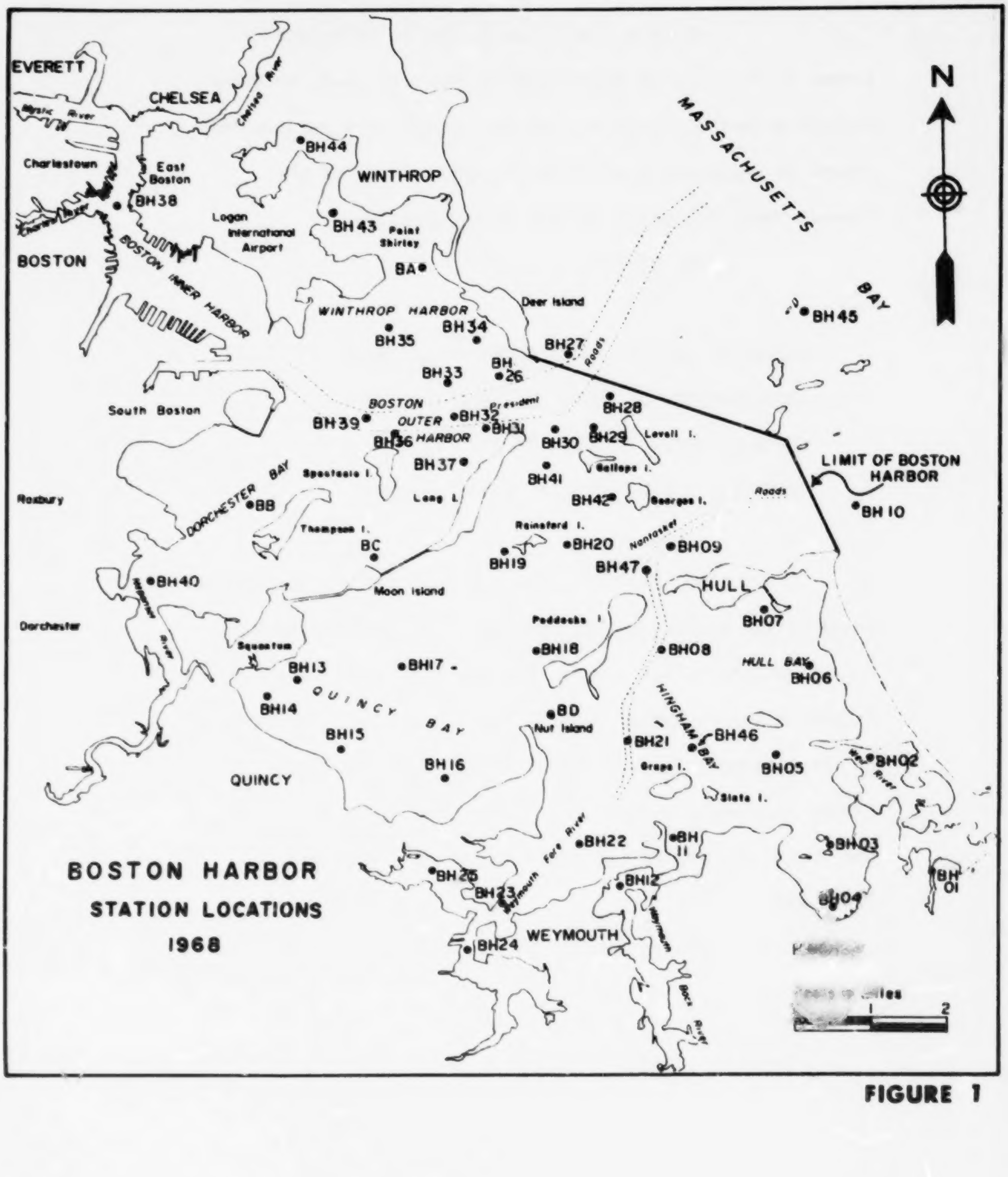
EVERETT
CHELSEA
Mystic River
Chelsea River
Charlestown
East Boston
BH44
WINTHROP
BH38
Logan International Airport
BH43
Point Shirley
BOSTON
BOSTON INNER HARBOR
BA
Deer Island
WINTHROP HARBOR
BH35
BH34
BH27
Roads
MASSACHUSETTS BAY
N
BH45
BH33
BH 26
South Boston
BOSTON OUTER HARBOR
President
BH28
BH39
BH32
BH31
BH30
BH29
Lovell I.
BH36
BH37
Gallops I.
Spectacle I.
Long I.
BH41
LIMIT OF BOSTON HARBOR
DORCHESTER BAY
Roxbury
BB
BH42
Georges I.
Roads
BH 10
Thompson I.
Rainsford I.
BC
BH20
Nantasket
BH09
BH19
BH47
BH40
Moon Island
HULL
Neponset River
Dorchester
BH07
Peddocks I.
Squantum
BH18
BH08
BH13
BH17
HULL BAY
BH06
QUINCY BAY
BH14
BD
HINGHAM BAY
BH15
Nut Island
BH21
BH46
BH16
Grape I.
BH05
BH02
Weir River
QUINCY
Slate I.
Weymouth Fore River
BH22
BH 11
BH03
BOSTON HARBOR
BH25
STATION LOCATIONS
BH23
BH12
1968
Weymouth Back River
BH04
BH 01
BH24
WEYMOUTH
Back River
Statute Miles
1
2

FIGURE 1

Alfred F. Ferullo

Mr. McMAHON. Thank you, Mr. Chairman.

At this time I would like to introduce Mr. Alfred F. Ferullo, an environmental engineer with the Water Pollution Control Division, who has worked very hard on this report in conjunction with the representatives of the Federal Water Pollution Control Administration.

Mr. Ferullo.

ALFRED F. FERULLO, ENVIRONMENTAL ENGINEER
MASSACHUSETTS DIVISION OF WATER POLLUTION
CONTROL, STATE OFFICE BUILDING, 100
CAMBRIDGE STREET, BOSTON, MASSACHUSETTS

Mr. FERULLO. The subcommittee was formed composed of the staff from the Massachusetts Division of Water Pollution Control and the New England Basins Office of the Federal Water Pollution Control Administration. The purpose of the subcommittee was to make a technical evaluation of issues previously read by Mr. Stein. This is a summary of the report directed to the full technical committee.

STUDY AREA

Boston Harbor has been described by the

Alfred F. Ferullo

Massachusetts Division of Water Pollution Control as the area or body of water inside or west of a line drawn from Point Allerton in Hull to the Boston Light to the southeastern point of Deer Island, as shown in Figure 1 of the brochure that I hope that you all have. This area includes Boston Inner Harbor, Boston Outer Harbor, Winthrop Harbor, Dorchester Bay, Quincy Bay, Hingham Bay and Hull Bay.

TECHNICAL EVALUATION

The findings of the subcommittee are summarized below:

Item (a)

The status report on pollution abatement in Boston Harbor is shown in Table 1 as recommended by the Massachusetts Division of Water Pollution Control. Status of pollution abatement in Boston Harbor by Federal installations is shown in Table 2, and a representative of the Federal Water Pollution Control Administration will discuss the Federal installations.

I would like to turn to Table 1:

Source of pollution, Deer Island waste treatment facility; type of treatment needed, additional chlorination capacity; date of completion, immediately.

Nut Island waste water treatment facility; treatment needed, additional chlorination capacity; date of completion, immediately.

MDC Winthrop Sewerage Bypass, tie to Deer Island facilities; date of completion, July of 1969.

Hull; treatment needed, secondary treatment: date of completion, March 1971.

Tidegates in the City of Boston: treatment needed, repair of gates: date of completion, May of 1971.

The City of Boston's Calf Pasture pumping station and City of Boston's Moon Island facility; treatment needed, tied to MDC sewerage system; date of completion, March of 1972.

Monsanto-Everett; treatment needed, tied to MDC sewerage system; date of completion, October 1969.

Item (b)

Boston Harbor has three different water classifications as shown in Table A and Figure 3. Class SA waters are located in Quincy Bay and Hingham Bay. Class SB waters are located throughout the rest of the harbor with the exception of the Inner Harbor area which is Class SC. Water quality classifications in certain areas are not being met in

Boston Harbor, as indicated in Figures 3 through 5. A discussion of the attainment of the water classification in each section of the harbor is as follows:

Inner Harbor

The Inner Harbor does not meet the Class SC classification due primarily to combined sewer overflows in the area. The water does not meet the criteria bacteriologically, chemically, or biologically.

Winthrop Harbor

Class SB standards are not being met in Winthrop Harbor both in the bacteriological and biological categories. The median coliform count per 100 ml was 3800 in Station BA and considerably greater closer to the Deer Island outfall.

The high bacterial counts may be attributed to the sewage overflows from the Winthrop area, inadequate chlorination of the Deer Island waste effluent and the Nut Island sludge which, during the sampling period, discharged without regard to the tidal cycle.

Boston Outer Harbor

The Deer Island sewage and sludge outfalls and the Nut Island sludge outfall are located in this area.

Although the Outer Harbor is classified SB, certain areas around outfalls will be considered "mixing zones" and thereby be exempt from the Class SB classification requirements.

The bacterial and biological quality of the Outer Harbor did not meet the SB water quality criteria.

More effective chlorination of the Deer Island sewage effluent is expected to improve the bacterial quality in this area. Release of sludge from both Deer Island and Nut Island only during the outgoing tide will also improve water quality in the Outer Harbor.

It is interesting to note that all samples collected in the Outer Harbor north of Spectacle Island showed oxygen values above 6.5 mg/l and therefore meet the dissolved oxygen requirement for Class SB waters.

Dorchester Bay

The median coliform count per 100 ml in Dorchester Bay was 730 or 30 more than the maximum allowable count of 700 for a Class SB water.

The bacterial and biological quality of this water does not meet the established criteria and is undoubtedly influenced by the combined sewers in the Dorchester Bay area along with Deer Island waste treatment facility effluent, Moon Island facility effluent, Neponset River water and waters from Boston Inner Harbor.

Quincy Bay, Hingham Bay and Hull Bay

Except for certain areas related to raw sewage discharges from Hull and effluent from the Nut Island facility the waters of these areas were of good quality and met the assigned chemical and bacteriological classification criteria. It should be noted, however, that the biological criteria were not met.

Some samples in this area showed orthophosphate phosphorus values in excess of 0.07 maximum limit. Although the average concentrations of phosphorus in most cases were under 0.07 mg/l, this is one parameter requiring future surveillance because of its relationship to algal growths.

Items (c and d)

The Massachusetts Division of Water Pollution Control conducted a survey in 1968 of all types of water pollution in Boston Harbor. During the survey, a great deal of floating debris was observed both in the inner and outer harbors.

Permits for burning of solid waste are issued

Alfred F. Ferullo

by the Massachusetts Department of Public Works. The Department also supervises the loading and unloading operations to ensure that all debris falling overboard is retained by "booms" and subsequently removed, thus resulting in improvement of the debris problem.

The Massachusetts Department of Public Works, Division of Waterways, has placed before the legislature a bill to authorize the Department to remove dilapidated piers, old barges and other floating debris from the harbor.

The United States Army Corps of Engineers is conducting a debris study in Boston Harbor which started in 1967 and is scheduled for completion in the summer of 1971. This study will determine the cost, feasibility, and economic justification of a program to solve the problem.

Control of dumping of garbage and refuse, except as mentioned above, is the primary responsibility of the local board of health in most Commonwealth cities and towns. The Division of Water Pollution Control's survey showed many areas containing garbage and refuse. Time and resources did not permit the development of an overall plan to control the problem.

Item (e)

Alfred F. Ferullo

Broad authority for oil pollution control has been given to the Massachusetts Division of Water Pollution Control with the passage of amendments to the Massachusetts Clean Waters Act in 1968. The Division now has the power to move immediately to contain and remove oil spills, and costs and expenses may subsequently be recovered from the person responsible for the spill. Rules and regulations are currently being drafted and will be issued this spring after a public hearing.

There are three Federal laws that relate to control of oil pollution: The Refuse Act of 1899; the Oil Pollution Act of 1924; and the Oil Pollution Act of 1961.

The Refuse Act of 1899 is administered by the Corps of Engineers. It reads in part, "...it shall not be lawful to throw, discharge or deposit or cause, suffer or procure to be thrown, discharged or deposited, either from or out of any ship, barge or other floating craft of any kind, or from the shore, wharf, manufacturing establishment or mill of any kind, any refuse matter of any kind or description whatever." The term "refuse" as used in the Act has been interpreted by the courts to include oil and other petroleum products.

Alfred F. Ferullo

The Oil Pollution Act of 1924 is administered by the Federal Water Pollution Control Administration. It prohibits "any grossly negligent or willful spilling, leaking, pumping, pouring, emitting, or emptying of oil" from any boat or vessel within territorial waters. The U. S. Congress held hearings recently on legislation to amend the law.

The Oil Pollution Act of 1961, administered by the U. S. Coast Guard, prohibits any discharge or escape of oil or oil mixture from a sea-going vessel of United States Registry or nationality with some exceptions.

Pollution from watercraft is under very general coverage of both State and Federal laws. New legislation being considered by the Congress would amend the Federal Water Pollution Control Act to include discharge from watercraft.

Item (f)

The Deep Tunnel Plan for collecting and disposing of overflows of mixed sewage and storm flows could provide a long term solution to a significant problem of water quality in the Boston Harbor area. It is also a project with major financial implications in a period where serious fiscal problems are being encountered by cities and towns, the State and

Federal Government. It should be noted that under current Federal and State water pollution control laws, this project is not eligible for either State or Federal aid, and all costs must be born by the affected communities. Implementation of a vast program such as the Deep Tunnel Proposal might require State and Federal enabling legislation.

Should this plan prove to be the most feasible, the Commonwealth of Massachusetts would suggest that implementation of this vast program would appear to be best financed by a Congressionally authorized civil works project, with the greatest percentage of contributions coming from the Federal government, and with cost sharing between the five communities, the MDC and the Commonwealth.

Item (g)

Assistance is now being given the Department of Defense as well as the Department of Transportation and the U. S. Coast Guard by the Federal Water Pollution Control Administration in regard to the implementation of treatment works at Federal installations.

Chairman STEIN. May we have Mr. Conley's presentation of Federal installations.

Edward J. Conley

EDWARD J. CONLEY, FEDERAL ACTIVITIES
COORDINATOR, NORTHEAST REGION, U. S.
DEPARTMENT OF THE INTERIOR, FEDERAL
WATER POLLUTION CONTROL ADMINISTRATION, BOSTON, MASSACHUSETTS

Mr. CONLEY. Mr. Chairman and conferees, my name is Edward Conley. I am the Federal Activities Coordinator for the Northeast Region of the FWPCA.

FEDERAL INSTALLATIONS

Executive Order 11288 requires the heads of Federal departments, agencies and establishments to provide leadership in the national effort to improve water quality through the prevention, control and abatement of water pollution from Federal activities in the United States. The Order requires that the Secretary of the Interior provide the necessary review, coordination and technical advice for all Federal departments, agencies, and establishments. The Federal installations, in turn, are required to cooperate with the Secretary, State and interstate agencies, and municipalities insofar as practicable and consistent with the interests of the United States and within available appropriations. Water pollution control requirements must be considered and included in the initial stages of planning for each new installation or project. Phased and orderly plans for installations must be developed and periodically revised as required. The Secretary of the Interior has assigned the responsibility of implementing the Executive Order to the Federal Water Pollution Control Administration.

The Federal installations in the Boston Harbor area are listed in Table 2. Also included in this table are the present sanitary and industrial waste flows and their disposition at each installation. A brief description of the waste disposal practices of the major sources of sanitary and industrial wastes from Federal installations follows:

Boston Naval Shipyard

All sanitary wastes from the Boston Naval Shipyard (Charlestown) shore facility (averaged 300,000 gallons per day) are discharged to the Boston sanitary sewer system. Cooling water (averaged 1,400,000 gallons per day) is discharged to Boston Harbor. A program has been implemented to eliminate the discharge of all industrial wastes from Boston Harbor. A wheelabrator unit is being installed to eliminate the need for some of the acids in the tank cleaning operation. The wheelabrator unit will be in operation by August 1969. Seventeen gallons per day will be collected in holding tanks to be picked up by commercial tank truck. The remaining 260 gallons per day will be neutralized and discharged to the Boston City Sewer System. The implementation of the two plans is scheduled for November 1969.

At Piers 4 and 6 there is an existing system to collect the wastes from the toilets and discharge them to the Boston City Sewer System. However, this collection system freezes during cold weather. As an interim measure the toilets will be reconnected to this system.

A program is being initiated to make the collection system operational year-round or to develop another system to eliminate this discharge to the harbor.

Dry Docks - Naval Shipyard & Naval Annex

A consulting engineer has been retained to design sewage collection systems and pumping stations to collect the wastes from the dry docks and discharge them to the Boston City Sewer System. The final design for these facilities is scheduled for completion by August 1969.

Edward J. Conley

Construction of this facility is scheduled in Fiscal Year 1970.

South Boston Naval Annex

All sanitary wastes from the shore facility (average flow 9,000 gallons per day) are discharged to the Boston sanitary sewer system.

Navy Ships Berthed in Boston Harbor

All Naval ships berthed in the harbor discharge sanitary wastes without treatment. The total flow discharged varies with the size and number of ships in port but is estimated to average 40,000 gallons per day. The Navy is engaged in a program to abate pollution from its vessels and, as part of this program, has installed a treatment device on board a destroyer based in Boston. This device is currently undergoing testing and evaluation.

Coast Guard's Base Boston

The Coast Guard is negotiating to retain an engineering consultant to complete the final design of a dockside sewerage collection system to collect wastes from urinals on the piers and ships berthed in the harbor and discharge them to the Boston sanitary sewer system. The construction contract is scheduled to be awarded by March 1970.

Edward J. Conley

Deer Island Light Station

This station has been scheduled to be automated by May 1970. Due to insufficient funds, there has been slippage in some of the scheduled dates for automating light stations.

If the schedule for automating this station is delayed beyond May 1970, an interim measure, such as an incinerator toilet or a macerator-chlorinator, will be installed so that this installation will comply with Executive Order 11288.

Nike Ajax Site B-36 (Hull)

Six thousand gallons per day of sanitary wastes are passed through a septic tank and chlorinated before discharge to the harbor.

A pump station and subsurface sand filter have been designed for this system. When these new facilities are added to the system, the wastes will flow from the septic tank to the pump station, then be pumped to the sand filter and chlorinated before discharge to the harbor. Construction of these facilities is scheduled to be complete by November 1969.

When this system is complete, it will be in conformance with Executive Order 11288.

Chairman STEIN. Thank you, Mr. Conley.

Mr. McMahon, will you continue.

Mr. McMAHON. Mr. Chairman, I would like to thank Mr. Ferullo and Mr. Conley for their presentations in their summary and conclusions. We are certainly delighted to state that there is a good, efficient, ongoing program for treatment of wastes from Federal installations.

I will call your attention to Table 1 in Mr. Ferullo's presentation. There were several changes. I would note these changes, and would hope that this would be part of the record when the transcript is made:

Under both the Dear Island and Nut Island waste water treatment facilities, rather than April 1, we put "immediately."

It also should be noted that this presently is being done, that the necessary piping has been put in in both plants and the additional chlorination equipment has been ordered.

Also, under Hull, where it said "primary treatment facility," this is actually going to be a secondary sewage treatment facility.

Chairman STEIN. Thank you.

Just for my information, what kind of secondary facility is that going to be, and when do you estimate there will be reduction of BOD from that facility?

Mr. McMAHON. I do not believe we have the engineering report in. It is hard to make an estimate on it without the engineering report.

Chairman STEIN. Thank you, Mr. McMahon.

Will you continue.

Mr. McMAHON. Mr. Chairman, we have a number of people here, state agencies, that have indicated a desire to speak.

I would first like to call on Mr. John C. Collins, who is the Director and Chief Engineer of the Department of Environmental Sanitation in the Massachusetts Department of Public Health.

JOHN C. COLLINS, DIRECTOR, DIVISION OF ENVIRONMENTAL HEALTH, MASSACHUSETTS DEPARTMENT OF PUBLIC HEALTH, 170 WASHINGTON STREET, BOSTON, MASSACHUSETTS

Mr. COLLINS. Thank you, Mr. McMahon.

John C. Collins

Mr. Chairman, the Department is very pleased with this opportunity to speak today.

The Department is vitally interested in and supports all those programs designed to provide adequate public health protection for the consumers of shellfish, for bathers, and for those using our waters for other recreational pursuits. The Department is acutely aware of the many problems facing our State and related Federal agencies in the protection of the public health, the preservation and utilization of our natural resources, and the general economic advantage of pollution control to the fisheries industry.

In the matter of solid wastes the Department has worked very closely with the Department of Public Works in the elimination of burning of refuse within the harbor area and in the promulgation of criteria aimed towards the elimination of prior unsatisfactory practices. The Department has also been instrumental in preventing the use of certain islands in Boston Harbor for the disposal of solid wastes. These efforts alone will hopefully assure the development and/or the preservation of such islands for recreational use and historical value. Also, the Department has continually upgraded the quality of air in Boston Harbor through the enforcement of the Department's air pollution regulations.

One of the major responsibilities of the Department of Public Health lies in the classification of shellfish growing areas in accordance with the recommendations of the Cooperative National Shellfish Sanitation program originally established by the U. S. Public Health Service in 1925. Shellfish areas in Massachusetts are classified into three major categories: (1) Open; (2) Restricted; and (3) Closed. Under the Cooperative Shellfish Program the Department has adopted adequate laws and regulations for the sanitary control of the shellfish industry, conducts continuous sanitary and bacteriological surveys of the growing areas, inspects shellfish plants and conducts sush additional inspections, laboratory investigations and control measures as may be necessary to insure that the shellfish reaching the consumer have been grown, harvested and processed in a sanitary manner. The sanitary survey is the evaluation of all factors having a bearing on the sanitary quality of shellfish growing area including sources of pollution, the effects of wind, tides and currents in the distribution and dilution of polluting materials, and bacteriological quality of the water. Under these guidelines, and because of the threatened withdrawal of the Massachusetts

John C. Collins

shellfish program from certification by the U. S. Public Health Service which would prohibit the interstate traffic of all shellfish harvested in Massachusetts, the Department has had to concentrate a major portion of its effort and shellfish sanitation staff in conducting complete sanitary surveys of Boston Harbor. These surveys, because of the extensive involvements are still continuing. However, certain shellfish areas in Boston Harbor have been reclassified and closed to the taking of shellfish for food purposes.

Generally these areas were formerly classified as Restricted and so-called Master Diggers were allowed to take shellfish for depuration (cleansing) only. All shellfish taken by Master Diggers must be submitted to a depuration plant approved by the Department of Public Health before going into the market. The reclassification of these areas has substantially reduced the harvesting of shellfish from Boston Harbor waters, but has resulted in the improved operation of the Newburyport Shellfish Treatment Plant by virtue of the fact that shellfish of lower initial bacterial density are now being submitted for depuration.

These shellfish areas are subject to pollution not only from the major sewer outfalls in Boston Harbor, but also from numerous shoreside combined sewer overflows which number approximately 90 and are described and located in the report of Camp, Dresser & McKee prepared for the City of Boston. In view of this, the Department feels that any study to assess pollution in Boston Harbor, such as is recommended by the Massachusetts Division of Water Pollution Control and the Federal Water Pollution Control Agency in the "Report on Pollution of the Navigable Waters of Boston Harbor", must be made broad enough in scope to include the effect of these shoreside overflows as they affect the bacterial quality of Boston Harbor waters. Because of the proximity of these overflows to shellfish and bathing areas, these sources of direct pollution are considered to be more dangerous to the public health than the voluminous discharge of treated, chlorinated sewage into the deep waters surrounding the major sewer outfalls of Boston Harbor. The Department urges, therefore, that immediate consideration be given to the control or elimination of these sources of pollution.

The productive shellfish areas in Boston Harbor immediately affected by the discharge of sewage from Deer Island are located in the vicinity of the Logan International Airport and comprise approximately 600 acres. I won't give our classifications because they would be meaningless to you. These were an area in Winthrop, closed January 1969, and two areas in East Boston, closed August 15 and August 20, 1967.

The two East Boston areas were reopened on July 17, 1968, when the Deer Island Sewage Treatment Plant went into operation and closed again on January 6, 1969, as well as another East Boston area on January 31, 1969, as a result of the suspension of chlorination at the Deer Island facility.

Additional shellfish areas in Boston Harbor totaling approximately 440 acres were closed because of shoreside discharges of sewage from combined sewer overflows, municipal outfalls discharging raw sewage, surface drainage systems infiltrated by sewage, etc. These shellfish areas were in other East Boston areas, closed January 9, 1968. and May 31, 1967; areas in South Boston closed on June 1, 1967; in Quincy, on September 19, 1967, and March 27, 1969; and in Hull on January 26, 1968.

The last remaining open shellfish areas in Boston Harbor, totaling approximately 800 acres, from which shellfish were taken directly for use as food were closed on March 26, 1969. The areas known as Wollaston Beach in

Quincy, Weir River in Hull, Hingham Harbor in Hingham, and Hull Bay in Hull, are now for the most part classified as restricted; and shellfish harvested from these areas may be used for food purposes after treatment at the Newburyport Shellfish Treatment Plant.

Now that the Deer Island Sewage Treatment Plant is in full operation and since the effluent is being properly chlorinated, the Department is resurveying those shellfish areas in Boston Harbor known to be affected by this discharge, with a view towards upgrading of classification to allow shellfish to be taken for depuration. The remaining shellfish areas of Boston Harbor determined to be affected by pollution from shoreside discharges will remain closed until such time as corrective measures to control or eliminate these sources of pollution are completed.

The Department is cooperating closely with the Metropolitan District Commission in studies, research, and bacterial samplings relative to discharges from both the Deer Island and the Nut Island Sewage Treatment Plants.

The Department feels that great strides in abatement of pollution have been made recently and are continuing to be made day by day. Certainly a great deel of

John C. Collins

work still remains to be done and in particular a great deal of money must be expended in reference to the correction of storm water overflows, without which many of the water uses, including bathing and shellfish harvesting, cannot be fully realized. (Again irrespective of the Deer Island and Nut Island Sewage Treatment Plants.) It therefore remains to find sources of funds to carry out these extensive corrective works.

The Metropolitan District Commission, as a result of a letter from the Department of Public Health and the Division of water Pollution Control, has gone ahead with year-round chlorination at the Deer and Nut Island Plants. Further, digested sludge is discharged on the outgoing tide only. With these two changes and increased dosage of chlorine, more effective chlorination is being practiced and it may be anticipated that the bacterial quality of the receiving waters affected by these discharges will be greatly improved. The Metropolitan District Commission, in placing into operation and improving the operation of the Deer Island facility, deserves credit for performing a difficult task in the face of budgetary and manpower limitations.

The Department recognizes that, while a great deal of work remains, there has been an expenditure of a large amount of money to date, of which a very small portion has been Federal funds, which has resulted in a marked improvement of the harbor waters. Such efforts must be continued and expanded where necessary to assure that the waters of Boston Harbor will be improved to the maximum achievable in the light of present scientific knowledge.

In conclusion, the Department will continue its surveys and very close cooperative work with the U. S. Public Health Service, the Metropolitan District Commission, the Division of Water Pollution Control and other State, Federal and local agencies, and hopefully in the not too distant future the full intended uses of Boston Harbor may be realized and adequate public health protection will be provided to the citizens of the Commonwealth.

Thank you, Mr. Chairman.

Chairman STEIN. Thank you very much.

Are there any comments or questions?

Mr. McMAHON. I have one question, Mr. Chairman

Jack, thank you for a very fine presentation. I would like to ask this one question:

Upon the closure of those two shellfish areas after cessation of chlorination at the Deer Island Sewage Treatment Plant, is it your opinion that now that chlorination is continuing that these areas may be opened?

Mr. COLLINS. We feel that they will, and we hope to prove this with the present surveys, yes.

We have, by previous surveys, shown direct pollution from this outfall in these areas, but we want to further prove that out.

Mr. McMAHON. Fine. Thank you.

Chairman STEIN. Mr. McMahon, will you continue.

Mr. McMAHON. Mr. Chairman, I would like to call on Commissioner Howard Whitmore of the Metropolitan District Commission.

HOWARD WHITMORE, JR., COMMISSIONER
METROPOLITAN DISTRICT COMMISSION
BOSTON, MASSACHUSETTS

Mr. WHITMORE. Mr. Chairman and members of the Committee and ladies and gentlemen.

Almost twenty-five years ago, the Metropolitan District Commission assumed the leadership by undertaking a comprehensive pollution control program. It assumed the responsibilities of intercepting, receiving, treating and disposing of the waste waters from a contributing population in excess of two million people from forty-two cities and towns in the Greater Boston area in 1945.

The construction program has included large trunk sewers, deep rock tunnels with pre-treatment works, pumping stations and two waste water treatment facilities, with a combined capacity in excess of a billion gallons per day.

There is little doubt but that the implementation of this comprehensive program has been a major factor in the marked improvement in the condition of the rivers tributary to the harbor, and that the two treatment plants will continue to play a significant role in the pollution abatement of the waters of Boston Harbor.

The Deer Island Sewage Treatment Plant, which began its operation in May 1968, is now approaching the design efficiency of the various unit processes of a primary treatment facility. The treatment procedures have significantly improved conditions in Boston Harbor. In the summer of 1968, the State Department of Public Health announced the Deer Island plant had cleared the way for reopening of four Winthrop town-owned beaches that had been closed since 1961. That agency also approved reactivation of two shellfish areas bordering Logan Airport for licensed commercial shellfishing, due to improvement in adjacent Harbor waters. No beaches are threatened with closing because of the Deer Island plant. Recreation conditions under M. D. C. jurisdiction in Boston Harbor have been greatly improved.

Within the next few months, it is expected that pertinent investigations into the water quality of the harbor will be initiated by the regulatory agencies of the Commonwealth.

Such investigations are required for an evaluation of the following:

1. Detailed information is needed on the "fertilization effect" of the discharge of treated sewage plant effluent into a marine environment.

2. Detailed information is needed on the various conditions of tidal water movements, mixing zones, and sea bottom topography.

3. Detailed information is needed on the most effective mixing techniques of treated effluents and

sea water, and the probable effects on the receiving water.

Parameters must be established by regulatory agencies that are realistic and attainable within the economic framework of today's society.

The Metropolitan District Commission has provided and will continue to provide leadership and be the forerunner in the field of pollution control and abatement. It appreciates the assistance and counsel it receives from the Federal Water Pollution Control Administration, its sister State agencies - the Department of Public Health and the Division of Water Pollution Control - the Legislature, and member communities of its Sewerage District. The Metropolitan District Commission will continue to cooperate willingly and assist in achieving the common objectives so urgently needed for recreation, boating, shellfish propogation, fishing and bathing, and, most important, the health of the public.

Although it has been mentioned, Mr. Chairman, I might add that, relative to the part of the summary report read by Mr. Ferullo concerning needed additional chlorination capacity at the M. D. C. Deer Island and Nut Island sewage treatment plants, that the required added chlorination capacity and funds for the added amount of chlorine have been provided; that chlorination year-round, not considered necessary or required until January of 1969, have now been provided for at an average estimated daily cost of $2,350.

Thank you, Mr. Chairman.

Chairman STEIN. Thank you, Commissioner.

Are there any comments or questions?

(No response.)

Chairman STEIN. If not, thank you very much.

Mr. McMahon.

Mr. McMAHON. I do not have any questions. I do have a comment.

Much has been said about the Deer Island Sewage Treatment Facility. I would like to make a point that this is the largest sewage treatment plant in New England. It is probably one of the most complex primary sewage plants in the country. Many of their operational start-ups are commensurate with the size and complexity of the plant.

I would also like to make the point that the M. D. C. has been most cooperative in working with our Division, and has done much in order to meet the water quality classification. Its personnel have worked long and hard and diligently to get this plant in operation, and significant improvements have occurred and will continue to occur.

I would like to call on Mr. Thomas Callaghan from the Massachusetts Port Authority, who is also the Chairman of the Boston Harbor Pollution Committee.

Is Mr. Callaghan here?

(No response.)

Mr. McMAHON. Mr. Chairman, I do have a presentation. If, perhaps Mr. Callaghan comes in later, we can have him give his remarks.

Chairman STEIN. Surely.

THOMAS C. McMAHON, DIRECTOR, DIVISION OF WATER POLLUTION, WATER RESOURCES COMMISSION, BOSTON, MASSACHUSETTS

Mr. McMAHON. Mr. Chairman, ladies and gentlemen, my name is Thomas C. McMahon, Director of Water Pollution Control, under the Massachusetts Water Resources Commission, in the Department of Natural Resources. Our agency was created under Chapter 685 of the Acts of 1966 with the responsibility to enhance the quality and value of the water resources of the Commonwealth and to establish a program for the prevention, control and abatement of water pollution.

Three companion pieces of legislation provided for a State bond issue of $150 million to assist cities, towns and districts in the construction of waste treatment facilities and two tax-inducement provisions for industries constructing their own treatment works.

Since the passage of these Acts, Massachusetts has adopted standards of water quality on all interstate, intrastate and coastal and marine waters. The interstate portions have been approved by the Federal Department of the Interior, thus making these Federal standards as well as State, and providing this State the maximum Federal grant percentages on eligible projects throughout the Commonwealth. An implementation schedule for corrective action has been established for some 330 industries and 130 communities in the State, and letters of intent indicating willingness to comply have been received from 95 per cent of those contacted. The total estimated price tag on a State-wide basis is nearly half a billion dollars, with approximately one-half to be cost-shared by the Federal Government, one-quarter by the State, and the remaining one-quarter by local financing.

Since corrective amendments to the Massachusetts Clean Waters Act, grant offers have been made to 43 communities

Thomas C. McMahon

representing some fifty-five million dollars worth of construction. This includes the prefinancing of some ten million dollars of the Federal share due to cutbacks on Federal appropriations below the authorizations of the Clean Water Restoration Act of 1966.

The problems of the harbor have been enumerated in the joint report, and background levels of quality have been evaluated throughout the entire harbor area. The resultant technical data indicates that with the exception of the inner harbor the water quality in Boston Harbor meets the State's criteria in 9 out of 11 parameters. It is also anticipated that the bacteriological requirements will be met after chlorination of all of the controllable discharges are effectuated.

Boston Harobr receives untreated and treated sewage discharges, combined sewer discharges, debris, garbage dumping, oil pollution, and pollution from pleasure and commercial craft. Each of these categories of wastes is being attacked by on-going programs at the State and/or Federal level with the exception of the combined sewer problem, which presently does not lend itself to any reasonable technical or economic solution.

Thomas C. McMahon

The future for Boston Harbor is bright. It is expected that each of the controllable industrial and municipal sources will have adequate facilities within the established implementation schedule and render the majority of Boston Harbor waters suitable for many high water quality water uses. The inner harbor solution nevertheless poses a typically complex high cost abatement solution normally associated with highly densely polulated urban areas. The solution proposed by the City of Boston's consulting engineers' report is estimated at about a half billion dollars. (Incidentally, this amount is over and above the half billion dollars we are estimating for the rest of the Commonwealth so far as construction of sewage treatment plants is concerned.) This Deep Tunnel Plan for collecting and disposing of overflows of mixed sewage and storm flows could provide a long-term solution to a significant problem of water quality in the Boston Harbor area. It is also a project, as stated by Governor Sargent, with major financial implications in a period where serious fiscal problems are being encountered by cities and towns, the State and Federal Governments.

Should this plan prove to be the most feasible, the Commonwealth of Massachusetts would suggest that implementation of this vast program would appear to be best financed by a Congressionally authorized civil works project, with the greatest percentage of contributions coming from the

Federal Government, and with cost sharing between the five communities, the M. D. C., and the Commonwealth.

In conclusion, it is most evident that there is a need for continuation of clean-up efforts by a number of agencies in order to provide for the maximum use of this outstanding metropolitan resource. Our direction to continue solving the many facets inherent in this problem has been made abundently clear. Fulfillment of aggressive and efficient programs of corrective action in the harbor and tributary areas will enable the people of the Commonwealth to make optimum utilization of these waters in this and future generations.

Thank you.

Chairman STEIN. Thank you, Mr. McMahon.

Mr. McMAHON. Mr. Chairman, I would like to ask Mr. Thomas Callaghan from the Massachusetts Port Authority, and also Chairman of the Boston Harbor Pollution Committee, if he would like to speak.

THOMAS CALLAGHAN

ASSISTANT TO THE DIRECTOR, MASSACHUSETTS PORT AUTHORITY

CHAIRMAN, BOSTON HARBOR POLLUTION COMMITTEE

BOSTON, MASSACHUSETTS

Thomas Callaghan

Mr. CALLAGHAN. Mr. Chairman, ladies and gentlemen, I am Thomas P. Callaghan, Assistant to the Executive Director at the Massachusetts Port Authority, and, as Mr. McMahon mentioned, the Chairman of the Harbor Pollution Committee.

The Harbor Pollution Committee is a voluntary association of about 30 government and business organizations designed to attempt to coordinate, improve and discipline for the benefit of the harbor.

The coordination, study, the exchange of information has gone on for approximately three years. That might be considered an excessive length of time, except for the fact that, as most people know, the water area of the harbor is roughly equivalent to the total land area of the City of Boston, and over the years and centuries it has been unfortunately a sewer, a no man's land, a frontier which is only now being attacked and settled and disciplined, thanks to the Federal Water Pollution Control Administration and the State Division of Water Pollution Control.

A tremendous amount of information has been presented during our monthly meetings at the Massachusetts Port Authority, and we have now gotten into a quite practical stage of activity.

Before. I mention what it is, I would like to say that the Massachusetts Port Authority does not have statutory responsibility in any appreciable way for harbor pollution or even for the regulation of activity within the harbor line. The Massachusetts Port Authority, as most people sometimes fail to realize, is an organization which has very definite responsibilities delegated to it by the Legislature, and the primary responsibilities are the operation and development of cargo handling facilities in the port area and the promotion of commerce.

But the Executive Director, Edward King, said to me about three years ago, "Look, get in there, try to do whatever we can to help," and fortunately we have had tremendous cooperation from all levels of government and from 15 or 20 business organizations and the League of Women Voters, which has been a very helpful organization, an organization which, I think, gives an understanding to the Legislature and to other elements of just what some people with special interests are trying to do.

At the present time the Harbor Pollution Committee, especially through the scientific input it received over the last year or so from the Federal and State organizations, understands, I think pretty well, what has to be done. The first things that we are trying to do are really in two parts:

One, we have supported two bills in the Legislature to seek funds and to seek disciplinary action.

The first bill is House 546, which was initiated in the discussions of the committee. It was sponsored by the Waterways Division of the State Department of Public Works. It was endorsed, and I underline this, because I think most people who have had any understanding of the State operations realize how difficult it is to get an endorsement from someone who actually needs more money and you are attempting to relieve them of a certain amount of money, but the Commissioner of Public Works, Mr. Ribbs, endorsed this bill, House 546, which would take $900,000 of the motor fuel tax and actually take it out of the general pot, which is used for highways, and put it into the water activity uses. Five hundred thousand dollars would go towards a $5,000,000 bond issue for ripping out dilapidated piers, a couple of hundred thousand dollars would go to maintenance dredging. Another couple of hundred thousand dollars would go towards the expenses of personnel and equipment.

Thomas Callaghan

So that I think that it is most important that anyone who cares to would try to help this particular bill. We had a hearing before the Committee on Natural Resources and Agriculture, and the League of Women Voters, the Waterways Division, and certain other members of the Harbor Pollution Committee appeared in favor of the bill. There was no opposition.

It went down to Ways and Means, along with the other bill that we are trying to have put through the Legislature, so that we can get into a real action program. What will happen to it down in Ways and Means, no one knows. We are fairly optimistic.

We feel that this $900,000, as long as it is endorsed by the State Department of Public Works, will not adversely affect the water activities which are being subsidized by a certain percentage of the motor fuel tax at the present time. At the present time one and one-fifth per cent goes to the Motor Boat Division and Marine Fisheries and so forth, but we are proposing that another four-fifths be taken from the general motor fuel tax, from the $13,000,000, or whatever it is at the present time, and used for this essential activity.

Along with that, we have coordinated with the Attorney General-first Attorney General Richardson and now Attorney General Quinn-through the good offices c Assistant Attorney General Harold Putnam; and we are supporting a bill, House No. 1959, which would authorize the Attorney General to go in and determine what dilapidated piers constitute a menace and nuisance, a fire hazard, give appropriate warnings and finally to go in and to rip those piers out through the State Department of Public Works, or under some other aggreeable agency that is under contractual operation. And the benefit would not accrue to the property owner, a lien would be placed on the upland so that the cost of ripping out these piers would not become a benefit to the owner. He would have to pay for it eventually, and we are attempting to work out the final details down in Ways and Means.

The other practical activity that we are engaged in (and I sort of relish the fact that we have arrived at a practical stage, because we have had a great deal of discussion and cooperating and prodding people to improve the harbor conditions), we are sponsoring, with the Coast Guard, which is a member of the Committee, an oil spill exercise, which we expect will be conducted in June. This will be a simulated mishap, a steering fault of a tanker leaving the harbor. The tanker will theoretically run aground on rocks near Castle Island, a couple of tanks will be ruptured, 30 gallons of heavy fuel oil will be leaking into the harbor, in theory.

We will use fire-fighting foam, which we assume is non-polluting,to simulate the oil. We will go through all the logistics of taking the oil boom, which the oil companies have purchased and are ready to use under various circumstances, and even to allow other organizations to use. We will have the whole communications operating. We will have skin divers go down and determine the extent of the rupture of tanks; we will test the ship, which will be a Coast Guard vessel, theoretically for explosive fumes.

We will move the foam, unless we get a real windy day, as you would move oil into an area where it can be vacuumed off the water, if that is the appropriate method that is decided by fellows like Don Corey and others on this subcommittee, so that I just want to report that the Committee is engaged in this type of cooperative effort, which is a

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credit to all of the 30 or 35 organizations of the Federal, State, local government and private interests that are engaged in the work of the pollution abatement, and I want to say that one of the most interested persons in this type of thing has been the State Division of Water Pollution Control.

As I mentioned, Don Corey is a tremendous asset, because he is taking action on the oil spills and he is being supported by Tom McMahon and the rest; and Howard Whitmore, the Commissioner of the M. D. C., has been most cooperative in all of the efforts that have come under his particular jurisdiction.

Thank you.

Chairman STEIN. Thank you, Mr. Callaghan.

Are there any comments or questions?

(No response.)

Chairman STEIN. If not, Mr. McMahon, you may continue.

Mr. McMAHON. I would ask at this time if there are any other State agencies that wish to make a presentation?

(No response.)

Mr. McMAHON. If not. I do have a few cards here. The first card is Mr. Devlin, who is representing the

James J. Devlin

City of Boston, the Public Works Department.

Mr. Devlin.

JAMES J. DEVLIN, ADMINISTRATIVE ASSISTANT,
CITY OF BOSTON PUBLIC WORKS DEPARTMENT
714 CITY HALL, BOSTON, MASSACHUSETTS

Mr. DEVLIN. Mr. Chairman, Mr. Director and conferees, I am James J. Devlin, representing Commissioner Cassazza, Commissioner of the Public Works Department of the City of Boston.

Commissioner Cassazza wishes to put on record that he is 100 per cent at the present time in favor of the policy as laid down by former Commissioner John F. Flagherty at the last session. Substantially that policy is this:

The administration is concerned with the pollution of Boston Harbor and is interested in cooperating fully in any program that may develop to reduce or eliminate such pollution.

With that end in view, in 1966 the City of Boston obtained an interest free loan of $220,000 from the

United States Department of H. U. D. That money was expended by the services of Camp, Dresser & McKee, who reported on what is now known as the Deep Tunnel Plan mentioned by His Excellency, the Governor, and Director McMahon. Of course the implementation of this plan will require considerable financial assistance from both the Federal and State agencies, and is, of course, beyond the financial capabilities of any or all of the cities and towns in the Metropolitan District.

Thank you.

Chairman STEIN. Thank you, sir.

Are there any comments or questions?

(No response.)

Chairman STEIN. Mr. McMahon.

Mr. McMAHON. I would like to call Mr. Jack Roberts of the Lewis Wharf Yacht Club.

JACK ROBERTS, LEWIS WHARF YACHT CLUB

63 ATLANTIC AVENUE, BOSTON, MASSACHUSETTS

Mr. ROBERTS. At two o'clock in the second Sunday in June, slack water happened in Boston Harbor. About 1:40 a tanker will come up through a section of the harbor with two tugs and a Boston Harbor pilot aboard. By the time it gets up to Chelsea Creek and swings to the turn, in will come a fleet of six or seven small craft carrying placards stating "Stop pollution in Boston Harbor" and "Prevent damage to water fowl." The pilot undoubtedly will radio to the Harbor Master and a police boat would come out, but at the same time the news media would be there with television cameras, and that is the kind of thing that is inevitable unless the pace of cleaning up the harbor changes.

From our experience, in the 12 months that has happened since the last conference, the amount of oil spillage in the harbor has not diminished one iota. This winter was as bad or worse than any previous winter, and although, either by coincidence or because of a smaller number of ships last spring, shortly after the conference it was much better, but it has reverted to the terrible and unnecessary condition that exists today.

Now, nobody wants to see action outside of a normal governmental process, and there is no reason why there should be. It takes no unobtainable Federal, State or local funds. All it takes is a determination to do the job.

The oil booms that could surround ships from the time that they appear at the docks and the tank farm until the time they leave exist. They are here in Boston Harbor now. There is no reason why a regulation could not be enforced to have these booms screen and completely surround the tankers during their hookup and pumping process. This should be logged by the ship's master and attested to as part of the process of clearing the harbor.

In the opinion of people who live and sail in the harbor, 90 per cent of the oil spillage comes from this one source, a source that is controllable with no expense to the State or Federal government.

The regulations that are being drafted by the Commonwealth to prevent oil spillage at the tank farms should be enacted as soon as possible.

Also, the licensing fees should be adequate to cover the enforcement of these regulations. The regulations, by themselves, as we see them as a result of a voluntary program, are not enough. They must be enforced and there must be a budget for inspectors and those inspectors should exist. It should be a self-funding program.

If the petroleum industry is causing this problem, then it seems only reasonable that they should pay for the cost of enforcing the problem.

Those two things can take place before the start of a fuel heating season next September. There is no reason why we have to go another year with the kind of conditions that can be alleviated.

There are things that we would like to see, from the Federal government:

We are very much concerned with a major offshore spillage that cannot be contained by the boom. As I understand it, there has not been sufficient research to develop a method of handling this spillage, nor is the organizational body coping with it immediately, yet time is of the essence in containing major oil spills.

The other thing that we would like to see is research and cleaning up of industrial tributaries to waterfront areas. For instance, here in Boston most of the problems come out of the Mystic River, the Charles River, and the Chelsea Creek.

There has been some work done in the pumping of air bubbles to prevent the oil spillage, where it cannot be contained or cleaned up, from entering the ocean. We think that more can be done. We think that it is feasible and technically possible, and it is desirable.

Thank you, Mr. Chairman.

Chairman STEIN. Thank you.

Are there any comments or questions of Mr. Roberts?

Mr. McMAHON. Thank you, Mr. Roberts, for an excellent presentation. I would like to make a couple of comments:

Number one, Chapter 648, which was mentioned here earlier, does allow the Commonwealth to act on an emergency basis and to expend up to $100,000 a year for the cleaning up of mysterious oil spills.

It also allows the Commonwealth to license all terminals and to give permits to waste oil collectors. There are presently being drafted in our office rules and regulations as to the general conduct of barges coming in and around oil terminals, and this public hearing is slated for May 16th, I believe, at ten o'clock on the 19th floor of the State Office Building. I would certainly invite Mr. Roberts to attend.

Also, I would like Mr. Corey, who is the head of our Oil Pollution Section, to discuss some of your individual problems with you. We are certainly willing to help you in any way that we possibly can.

Mr. ROBERTS. Thank you very much.

Chairman STEIN. We generally do not take questions from the floor, but we will.

May we have your name?

Mrs. TREPLAN. Mrs. Treplan, League of Women Voters.

Would you tell us more about this idea of the boom around the ships? Is it being used in other harbors, and how effective has it been?

Mr. ROBERTS. It is in use. It is on a standby use, as I understand it, for every installation here within the harbor.

It is of great use under the normal sea conditions that exist in the harbor. We do not have a great deal of wave action within the harbor, and, therefore, if you have a surface floating continuous chain around a potential source of oil spillage, the oil does not flow over the top of this floating boom, and because it normally rides on the surface, it does not disperse underneath. It is contained.

You do need some method of dealing with the oil when the ship leaves. There are chemicals available, which are also stockpiled here in Boston, that either will emulsify that oil or cause the oil to be heavier than the water and sink to the bottom. The technology does exist, and it is not an expensive thing to do.

Chairman STEIN. To supplement that, as factual information, there have been a number of booms in various harbors around the country, and the reports are that they have proven effective and have worked where the tides and the wave action are not too significant a factor. Where it is calm enough, the booms are effective in many cases.

Mr. McMahon?

Mr. McMAHON. I would like to next call on Mrs. James R. Ullman representing the League of Women Voters in the City of Boston.

MRS. JAMES R. ULLMAN, LEAGUE OF WOMEN VOTERS
OF BOSTON, 453 WASHINGTON STREET, BOSTON,
MASSACHUSETTS

Mrs. ULLMAN. Mr. Chairman and ladies and gentlemen, I am Marian Ullman. I am a member of the League of Women Voters of Boston.

Mrs. James R. Ullman

The League of Women Voters has had a stand on the control of water pollution for the past ten years. The League believes in the need to treat water more as a commodity and less as a free resource and vigorously supports policies and procedures which promote comprehensive long-range planning for conservation and development of water resources and improvement of water quality.

Recently the League of Women Voters has taken a position on Boston Harbor. Under that position, the Boston League supports:

1. Measures to eliminate dumping of raw sewage into the harbor.

2. Measures to promote the use of modern methods of solid waste disposal.

3. Enforcement of laws to control dumping and burning in the harbor.

4. Elimination of rotting piers and other decaying waterfront structures.

5. Controls for containment of oil spills and seepage.

6. Measures to put Deer Island Sewage Treatment Plant into efficient and continuous operation.

Mrs. James R. Ullman

The Boston League is opposed to construction of new facilities which would result in increased water pollution, including pollution fron thermal and radiation waste. Under this position the League has gone on record recently with the Boston City Council as favoring the location of EXPO '76 on Boston Harbor only if present pollution can be abated and further pollution prevented.

The Boston League is opposed to the further filling in of the harbor which might cause a decrease in the tidal flow so necessary to maintain the quality of the harbor.

Thank you.

Chairman STEIN. Are there any comments or questions?

(No response.)

Chairman STEIN. I know the League is a national organization, and I was intereted in your comment on favoring the location of EXPO '76 in Boston Harbor only if present pollution can be abated and further pollution prevented. I wonder if the Philadelphia League has the same attitude toward EXPO?

Mrs. ULLMAN. I do not know.

Chairman STEIN. At this time we will stand recessed for ten minutes.

(Short recess.)

Chairman STEIN. Let us reconvene.

Mr. McMahon, do you have any more statements?

Mr. McMAHON. I do not have any other requests. However, if anyone is here who wishes to make a statement and did not sign a card, please identify yourself and feel free to come up and make a statement.

(No response.)

Mr. McMAHON. This concludes, then, the state testimony, Mr. Chairman.

Chairman STEIN. Mr. Klashman?

Mr. KLASHMAN. The only Federal agency that has indicated that they wished to make a statement is Mr. Richard E. Griffith.

Is there anybody besides him?

(No response.)

Mr. KLASHMAN. Mr. Griffith.

Richard E. Griffith

RICHARD E. GRIFFITH, DIRECTOR, NORTHEAST
REGION, U. S. DEPARTMENT OF THE INTERIOR
BUREAU OF SPORT FISHERIES AND WILDLIFE,
BOSTON, MASSACHUSETTS

Mr. GRIFFITH. Chairman Stein, conferees, ladies and gentlemen:

My name is Richard E. Griffith. I am Director of the Northeast Region of the Bureau of Sport Fisheries and Wildlife. This Bureau, along with the Bureau of Commercial Fisheries, makes up the U. S. Fish and Wildlife Service. By agreement with Regional Director John T. Gharrett, Bureau of Commercial Fisheries, the statement I am presenting represents our combined views.

We are pleased to have the opportunity to speak at this conference. Unfortunately, I cannot report that the depressing effects of pollution upon the fish and wildlife resources of Boston Harbor and its tributaries have been eliminated, or even reduced significantly. We still have a long way to go. I am optimistic, though, because we, supported by the general public, are now actively seeking ways to reduce pollution.

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As the expanding human populations achieve more leisure time there will be an increased need for greater recreational opportunities, especially for fishing and boating. Cleanup of the polluted areas will provide many thousands of additional man days of fishing. It will also help distribute fishing pressure more evenly on the available waters. If the myriad problems restricting fishing opportunities can be solved and an outstanding quality of angling is provided, a very important contribution towards meeting the ever-increasing demands for outdoor recreation will have been made.

Boston Harbor's potential for satisfying part of this demand is enormous. The Harbor and its tributaries, lying adjacent to the metropolitan area of Boston, offer an opportunity to provide a wholesome recreational outlet for millions of people.

In 1965 the total population of the Boston Area was 2,600,000 people. According to our National Survey of Fishing and Hunting, there are about 166,400 salt-water fishermen in the Boston area who expend a total of 2,230,000 man days annually. However, as closely as we can estimate, the 28,000 acre Boston Harbor annually supports only 84,000 man-days of fishing. This is a modest use of three man-days per acre of bay water.

By the year 2000 it is expected that there will be 182,000 salt-water fishermen in the Boston area having a fishing pressure potential of 2,700,000 man-days each year. If we assume that the fishermen will spend half of their time fishing elsewhere, then about 1,350,000 fisher man-days would be spent in the Boston Harbor area. The pressure on Boston Harbor would then be 50 man-days per acre per year, or an average of 7,000 fishermen per day during a 200-day season. This is still a relatively moderate rate of fishing. We should be able to achieve it, and hopefully, if by then Boston Harbor is essentially pollution free, we may better this record. Assigning a value of $1.50 per fisher man-day the annual value of this recreational resource would exceed $2,000,000. The difference between the current pressure and the future potential use is 1,250,000 man-days of recreation which represents more than the normal population increase over the next 30 years; it represents, to an important degree, the effect of improved water quality in Boston Bay.

In the State and Federal cooperative work on the restoration of anadromous fish runs in the Charles River,

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a preliminary estimate shows that a run of American shad could support an annual sport fishery amounting to 30,000 fisherman-days. The restoration of shad, alewives, and other anadromous species will require fish passage facilities over the several dams in this river; however, these facilities alone cannot restore fish runs in the Charles River. Pollution abatement in the river as well as in the bay is also required.

There are approximately 4,500 acres of shellfish habitat in the harbor. Shellfish digging is prohibited or restricted on all but 500 acres because of pollution, resulting in an annual loss of 7,800 bushels of shellfish. An alarming item is the report that 1,113 acres have been closed since June 1, 1967. Even more disturbing are the recent closures. Last month, the 500 acres open last year were restricted and additional areas, previously moderately polluted and restricted, are now grossly polluted and closed.

The continued reduction in our water-related resources, together with the commercial and recreational values they support, can be reduced. To accomplish this will require complete cooperation among all levels of government and industry directed towards a cleaner Boston Harbor and its tributaries. Can we afford to wait any longer? I think not. An all-out campaign to eliminate pollution in Boston Harbor should be given a high priority.

Thank you, Mr. Chairman.

Chairman STEIN. Thank you, Mr. Griffith.

Are there any comments or questions?

Mr. BROWNELL. Mr. Griffith, you are assigning a value of $1.50 per fisher man-day. The annual value you would receive is $2,000,000. That seems to me rather low.

Mr. GRIFFITH. I would agree, sir. That is a very conservative figure. However, it is the figure that has been used as a result of a Congressional study of values that might be assigned to Federal water development projects.

It represents a figure that has been used for a long period of time, and it was the consensus of the several agencies that became involved in making studies of fish and wildlife resources that might be affected by Federal water development projects, that this figure, even though modest, should be used.

I think that this is a rock-bottom estimate of recreational value. My personal opinion is, that the value of the resource that would be enhanced by pollution control in

Boston Harbor is far greater than I have indicated.

Mr. BROWNELL. Thank you very much, Mr. Griffith.

Chairman STEIN. Mr. McMahon?

Mr. McMAHON. Mr. Griffith, I would like to ask one question:

In Boston Harbor which pollution parameter, in your opinion, is most damaging to fin fishing?

Mr. GRIFFITH. I believe, sir, it is the domestic sewage disposal into the harbor along with industrial sewage, because these wastes, in combination, serve to create a degraded environment that is not capable of supporting the food organisms that are essential to fish life, and thus limits the movement of fish through harbor waters.

It also tends, of course, to limit their availability to recreational fishermen, and these pollution factors have a very serious limiting effect on what would otherwise be a substantial movement of anadromous fish from the harbor area into the tributary streams.

Mr. McMAHON. Is this primarily a matter of bottom deposits or of contaminants actually in the water, as such?

Mr. GRIFFITH. It is a combination, sir.

The accumulation on the bottom of course, renders substantial areas of the bay bottom unsuitable for organisms that we could expect to occur there. The damage caused by the elimination of an organism in the total food chain is very important, but the contaminants within the water column are also quite harmful.

Mr. McMAHON. Thank you very much.

Chairman STEIN. Mr. Klashman?

Mr. KLASHMAN. I would like to now call on Mr. Walter Newman, the New England River Basins Commission.

WALTER M. NEWMAN, SENIOR STAFF ASSOCIATE, NEW ENGLAND RIVER BASINS COMMISSION

Mr. NEWMAN. Mr. Chairman, I am Walter M. Newman, Senior Staff Associate of the New England River Basins Commission. I think it is apparent to all persons concerned about Boston Harbor that its problems are indeed complex. I think it is also clearly recognized that the development, conservation, and utilization of the water and related land resources of the harbor offer a unique potential and opportunity to enhance the lives of the people of Boston, the Commonwealth, the region and, indeed, the nation.

Adequate water quality is one of the pivotal elements which must be achieved if we are to attain the goals for the harbor. The harbor's water quality problems are particularly complex, and are inexorably linked to the surrounding metropolitan area and the water sheds which drain toward the harbor. It is entirely appropriate that we seek a long-term solution to the problem of water quality management in the harbor considering the influence and impact of the tributary areas.

I would, therefore, like to recommend to the conferees that a comprehensive water quality management plan, sections of which are currently under development by various agencies, be completed for the Boston Harbor Drainage Area by an inter-agency State, Federal and regional group including, but not limited to, the Massachusetts Division of Water Resources, the Metropolitan District Commission, the Metropolitan Area Planning Council, and other appropriate agencies. The New England River Basins Commission has a statutory responsibility under the Water Resources Planning Act to prepare a comprehensive plan of water and related land resources for the entire New England area. The Commission can serve as a coordinating vehicle and integrate this water quality plan into the comprehensive water and related land resources plan for the Southeastern New England Region which includes Boston Harbor. The Massachusetts Division of Water Pollution Control and the Federal Water Pollution Control Administration should provide leadership for the group. The plan should be completed by June 1972, with interim reports and recommendations published each year.

The program shall include but not be limited to:

1. A program for water quality control and enhancement through the year 2020. This program would include waste water collection and treatment facilities, and control and/or disposal of storm water overflows.

2. Analysis and recommendations of governmental authorities, structures or laws for achieving the plan.

3. Recommendations on financial arrangements and apportionment of costs for development, construction, and operation of the water quality management systems proposed, including Federal, State, regional, local, and private shares.

Following review and approval of this water quality management plan by the conferees and the New England River Basins Commission, it can be submitted to the Congress through the President of the United States and to the Governor and Legislature of the Commonwealth of Massachusetts.

I would also like to recommend that as a further step toward advancing the Boston Harbor water quality control program the Commonwealth of Massachusetts adopt through legislation a marina control law and a boat pollution control law for the protection of inland and coastal marine waters.

Thank you.

Chairman STEIN. Thank you.

Are there any questions or comments?

(No response.)

Chairman STEIN. Thank you very much, Mr. Newman, for an excellent statement.

Mr. Klashman?

Mr. KLASHMAN. Are there any other Federal agencies that would like to be heard?

(No response.)

Mr. KLASHMAN. If not, this concludes the Federal presentation.

Chairman STEIN. Are there any other statements, Mr. McMahon?

Mr. McMAHON. I have no other statements.

Mr. Chairman, the State has certain recommendations that I would like to make at this time.

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Thomas McMahon

The first recommendation, and I will read this:

The Massachusetts Division of Water Pollution Control recommends that the following be adopted:

That the implementation plans set forth in the following Table 1 by the Commonwealth of Massachusetts for the various municipalities and industries be approved.

This is the Table 1 that Mr. Ferullo made in his presentation, together with the corrections that I made in the locations; on the Deer and Nut Island Water Treatment Facilities change to "immediately," and also secondary treatment for the Town of Hull. The rest is essentially the same as it was in the original presentation. I will not read it, unless someone specifically requests it.

The second recommendation is:

That a consulting engineering firm be engaged to:

a. Evaluate the tidal and current patterns and the dispersion characteristics of Boston Harbor, particularly as it effects the Deer Island and Nut Island treatment plants. Evaluation would include the utilization of mathematical modeling techniques directed to the determination of mixing zones, and recommendations for sludge disposal and chlorination practices. This report shall be completed by the winter of 1970-71, and an implementation schedule incorporating the approved recommendations shall be developed directly thereafter.

b. Provide an evaluation and recommendation as to the most practical and economical solution to the overall Boston Harbor problem considering the effects of tributary streams and combined sewer overflows.

Mr. Chairman, I would also like to add a third recommendation, as far as the State is concerned, and this reads as follows:

In noting the detrimental effect of Federal construction grant cutbacks in appropriations on State water pollution control programs, the conferees of the Commonwealth of Massachusetts urge that the Federal Water Pollution Control Administration and the Secretary of Interior recommend to the Congress of the United States the adoption of a fiscal program consistent with the implementation programs adopted by the States throughout the nation.

It is further recommended that legislative amendments to the Federal Water Pollution Control Act do not vary the present grant percentages to communities for construction of waste treatment facilities, or if alternative means of financing are introduced, the alternative financing measures are the equivalent of the present percentages specified in the Act.

The conferees would also urge the passage of a separate appropriation to finance the reimbursable clause of the Federal Act to repay States that have or will prefinance the eligible Federal portions of treatment facilities in anticipation of future Federal reimbursements.

That concludes the recommendations of the State.

Chairman STEIN. Mr. McMahon, I have a clarifying question:

In your Recommendation 2 you say, "that a consulting engineering firm be engaged." By whom?

Mr. McMAHON. By our Division under research and demonstration grants that are available.

Chairman STEIN. Thank you.

Does that conclude the State presentation?

Mr. McMAHON. Yes, it does.

Chairman STEIN. Are there any more people who want to make a comment, because we are going to terminate the discussion now?

(No response.)

Chairman STEIN. We will have a short executive session of the conferees, and come up with a statement, I hope, within 10 or 15 munutes.

We want to give everyone a full opportunity to say what they have to say. If there is any one in the room who feels that he wants to add something to the record before we go in, we will hear from him now. If not, we will have this executive session.

We are going to keep the record open for a week: if you have any technical or editorial changes on your statements, or corrections that are to be made because a figure might have been a little off, or you want to improve your statement editorially.

We will now recess for executive session for about 15 minutes.

(Short recess.)

Chairman STEIN. Let us reconvene.

I am happy to announce that the conferees representing the State of Massachusetts and the Federal Government have arrived at unanimous conclusions and recommendations.

Closing Statement

I do think that this is a significant breakthrough in the Boston Harbor situation, and given existing circumstances I think we do have an action program which should provide clearer water in the harbor.

A good deal of credit should be given to the Massachusetts Division of Water Pollution Control, because, in dealing with the complicated problem that you have in Boston Harbor and the legacy of pollution we have had from past misuse, the program that has been developed is as imaginative and forward-looking as any we have in the country, and I think the people in Massachusetts should be very proud of this.

The conferees would agree that the best way to deal with this problem is to go forward with the implementation plan set forth in Table 1 by the Commonwealth of Massachusetts for the various municipalities and industries. This is a realistic and tight program, and one which can be achieved and which, if achieved, will give us a much better water quality situation in Boston Harbor.

We also recognize, as Massachusetts points out, that we really do not have all the answers at present, therefore, Recommendation 2, that the Division hire a consulting engineering firm to evaluate and report on the tides and currents and the dispersion characteristics of Boston Harbor, with particular reference to sludge disposal and chlorination practices bids fair to satisfy an important need. If we are going to have an effective, continuing water quality management program in Boston Harbor, we need such a report.

Very little is known in many areas of the country about dispersion characteristics and currents, and as we begin to meet our problem of getting away from gross pollution, we find that we have to evaluate dispersion characteristics and currents of rivers. This may very well be the thrust of future pollution control, because it often appears that where and when we put in the waste will have almost as much significance as how much we put in, and therefore, the development of more knowledge of dispersion characteristics and currents is wholly necessary.

Boston, like many of the older cities, has also inherited, along with its historical tradition, the combined sewer problem, and we recognize that the older cities of this country that have this combined sewer problem have a special pollution problem over and above the 'normal' one of treating wastes. 'Normal' treatment, whatever degree it is and however expensive it may be,sometimes gets dwarfed by the problem of storm waters.

There have been some imaginative programs brought out here. As both Governor Sargent and Mr. McMahon have pointed out, not only is the technical solution of the problem important, but one must also take into consideration the ability to finance it; and the costs of handling storm water overflows are, so far as we know, tremendous. At least the studies so far in the Boston area have indicated that the magnitude of the costs here is as great as it is anywhere else, and that is considerable, indeed.

It should be pointed out that what we are going to achieve by any water pollution abatement program will be modified considerably unless we also find a way of handling the storm water overflow. As has been pointed out, all the shellfish beds are not going to be open unless we have the storm water overflow problem licked, nor will we be able to make maximum use of the Boston Harbor water and tributary water for recreation without the control of some storm water overflow.

From a recreational point of view this becomes a most difficult problem, because the worst kind of pollution problem is one where on some days the water is relatively clean and on some days relatively polluted. People do not, as a rule, check after a rain to see if it is polluted. If the water is notoriously polluted, everyone stays away from it, although that does not make it less polluted. But where you have intermittent pollution you have a very dangereous situation.

I regard the proposal of the Massachusetts agency to move forward on this problem as significant, indeed. The Massachusetts Division has carefully analyzed the problems affecting Boston Harbor and has worked up an approach to their solution.

In addition, with reference to what may be needed here, one of the recommendations of the conferees is, that a state marina control law and a better boat pollution control law for the protection of inland and coastal marine waters are needed. We all recognize the significant pollution problem caused by wastes from fixed industrial and municipal sources, but the use of harbor or inland water or tidal water by the number of boats that you have here during the recreation season also presents a significant problem, and this would have to be controlled.

We would also recommend that action be taken to assure that all pollution abatement measures are taken to control the Federal installations within the schedules outlined here.

Closing Statement

Now, the statement of the Massachusetts conferee in dealing with Federal construction grants and financing and legislative amendments to the Federal Water Pollution Control Act on grant percentages and appropriations is one that is made by the conferee representing the State. The Federal conferees are prohibited by Federal law from taking a position on this matter; so this will be noted in the summary as a recommendation from the State conferee.

In addition to that, from the long range point of view, we have to consider the comprehensive planning in the area, and I think if you will refer to the recommendation made by Mr. Newman of the New England River Basin Commission, he pointed out the need for such long range comprehensive planning if we are going to stay on top of the program. The conferees would endorse the development of a comprehensive water quality management plan as being developed by the New England River Basin Commission in cooperation with Federal and State agencies, and would consider that to be a vital part of the future control of pollution and the enhancement of water quality in the Boston Harbor area.

Are there any other comments or modifications of the summary or statements that you wish to make?

Mr. McMAHON. I have none.

Chairman STEIN. If not, I think that this has been a really historic conference. We have achieved, I think, a major breakthrough, and I think it is exhilarating indeed, that the State and Federal people should be working so closely together on this problem. As I look back on the presentations and joint report made here, I feel that we, State and Federal people working together to deal with a joint problem, have taken a big step forward. It is going to need this kind of cooperation to take care of the problem.

We both have so much to do in cleaning up pollution, that we have to work jointly to achieve maximum impact and avoid overlapping and conflicts.

The State is to be particularly commended for developing this program, and I would also like to commend the cooperation and constructive statements of all those from the other agencies who testified here, the many agencies in the metropolitan area who worked on this, because without their help and cooperation this program certainly could not be put together, and even if it were put together, without their continued help and cooperation, insight, and criticism we are not going to make it.

Closing Statement

With that, I want to thank you all for coming, staying with us, and participating with us. I look forward, with you, to a cleaner Boston Harbor.

(Whereupon, at 12:13 p.m., the conference was concluded.)

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